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Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at $8.50 for the three-volume set.

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **4196**

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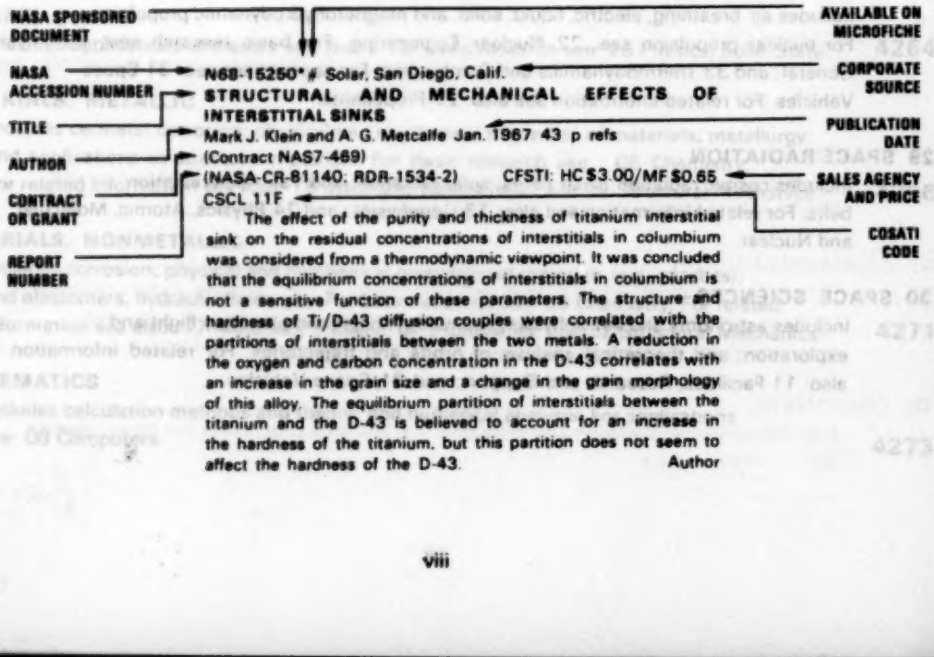
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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-37597 Iowa State Univ. of Science and Technology, Ames.
TURBULENCE IN THE WAKE OF A BODY OF REVOLUTION
Rene Chevray (Ph.D. Thesis) 1967 p 105
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-16784

The wake behind a six-to-one prolate spheroid has been studied for a Reynolds number equal to 2.75×10^6 at twelve sections downstream to 18 diameters from the stern of the body. Three distinct phases have been given particular consideration in this study: the gross characteristics of the wake, the turbulence characteristics, and the fine structure of turbulence. The flow pattern has been determined and an analytical expression has been derived to express the way in which the mean characteristics of the axisymmetric wake in general develop in the self-preserved region. Experimental and theoretical results agree. The normal and tangential Reynolds stresses were measured throughout the flow and their magnitudes have been checked through the momentum and mean-energy equations. In an attempt to relate the different turbulence characteristics to existing theories, measurements have been made of the spectral density function, micro- and macroscales and intermittency of turbulence together with the autocorrelation function. Dissert. Abstr.

N68-37762# Advisory Group for Aerospace Research and Development, Paris (France).
CALIBRATION MODELS FOR DYNAMIC STABILITY TESTS
R. Fail (RAE, Bedford, Engl.) and H. C. Garner (Natl. Phys. Lab., Teddington, Engl.) 1968 9 p 8 refs
(AGARD-563) CFSTI: HC $3.00/MF $0.65

This report describes three further calibration models in the AGARD series. Model G: A slender wing. Suitable for tests over a wide speed range. Fitted with a fin and a sting fairing. Model H: A thin tapered wing suitable for high speed tests. Model J: A 10° semi-angle cone, suitable for high supersonic speed testing. Author

N68-37763# Advisory Group for Aerospace Research and Development, Paris (France).
VERIFICATION OF THREE-DIMENSIONAL FLUTTER CALCULATIONS BY MEANS OF WIND TUNNEL TESTS ON A FLEXIBLE MODEL
R. Destuynder (ONERA) and L. Darovsky (ONERA) Oct. 1968 22 p 2 refs Presented at the 23rd meeting of the Struct. and Mater. Panel, Chatillon-sous-Bagneux, 3–7 Oct. 1968
(AGARD-562) CFSTI: HC $3.00/MF $0.65

The model reproduced the planform of a supersonic aeroplane. Its mass and stiffness characteristics were chosen to ensure that the tests provided a valuable check on the theoretical method used to predict the behaviour of the model: in particular, the frequencies of the model showed significant changes in the wind stream, the model approached a flutter condition, and its natural mode shapes included chordwise as well as spanwise deformation. The calculations were made with a programme prepared by Sud-Aviation. The determination of the unsteady aerodynamic forces was based on lifting-surface theory. Comparison between the theoretical and experimental results justifies the method of calculation used, even though the model contained components such as nacelles and fuselage which were not included in the theoretical aerodynamic representation. Author

N68-37811# National Aerospace Lab., Amsterdam (Netherlands)
SYMMETRICAL SUBSONIC POTENTIAL FLOWS AROUND QUASI-ELLIPTICAL AEROFOIL SECTIONS
J. W. Boerstoel 20 Mar. 1968 38 p 4 refs Supported in part by Neth. Develop. Board
(NLR-TR-68016-U) CFSTI: HC $3.00/MF $0.65

Presents detailed geometrical data of fifteen symmetrical quasi elliptical air foil sections and the corresponding pressure distributions in high subsonic potential flows. Within the scope of potential theory no approximations have been made. Author

N68-37854*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF A PARASOL-WING BODY COMBINATION UTILIZING FAVORABLE LIFT INTERFERENCE AT MACH NUMBERS FROM 3.00 TO 4.63
Odell A. Morris and Robert J. Mack Washington Oct. 1968 38 p 9 refs
(NASA-TN-D-4855) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation has been conducted in the Langley Unitary Plan wind tunnel at Mach numbers from 3.00 to 4.63 to determine the longitudinal aerodynamic characteristics of a parasol-wing–body model. The model has a swept wing with a curved leading edge and a body with circular cross sections and a Von Karman forebody shape. Variations in wing position and forebody shape were also studied. Results of the investigation show that large favorable lift interferences were obtained at zero angle of attack for all configurations with the largest interference values being measured at Mach numbers from 4.00 to 4.63 in tests of low, single strut configuration. Variation in wing vertical position from a high to a low position improved the interference lift increments at the higher Mach numbers (4.00 to 4.63) with a corresponding increase in the maximum values of the lift-drag ratio. Variations in forebody shape from the basic body resulted in only small changes in the maximum values of the lift-drag ratio. Theoretical calculations of the lift-drag curve for the basic configuration at a Mach number of 3.00 showed good agreement with the experimental data. Author

N68-37950# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPERSONIC FLOW PAST BODIES OF ROTATION WITH ANGULAR GAP [SVERKHZVUKOVOYE OBTEKANIYE TEL VRASHCHENIYA S KOL'TSEVYMI UGLUBLENIYAMI]

M. G. Morozov and Yu. V. Baryshev 17 Aug. 1968 11 p refs Transl. into ENGLISH from Univ. Vestnik. Seri. 1, Mat., Mekhan. (Moscow), no. 6, 1966 p 108–113
(FTD-MT-24-163-67; AD-668103)

The results of an experimental investigation of supersonic flows past bodies of revolution with annular recesses of various lengths by means of a wind tunnel in the Mach ranges M = 1.79 to 3.69 and Re = 290,000 to 1,050,000 for 1 cm are presented. Various cylindrical models 6 to 60 mm in diameter with conical forward sections and with annular recesses of different lengths and depths were considered. The length of the recess 1 sub cr called critical for which the flows changed from flows with one to flows with two stagnation regions and also its ratio to its depth were determined experimentally from schlieren photographs. An attempt was made to establish the relationship between 1 sub cr/h and M and Re. The results of measurements on aerodynamic drag confirmed the conclusions from an analysis of the available data stating that the transition from the first to the second type of flow is accompanied by a jump-type increase in drag, thus an increase in the diameter of the rear cylinder in the region 1 sub cr may lead to a decrease in drag, and vice versa. The transition from the first type of flow to the second occurs in a quite narrow range of the value K1 sub cr/L = 12 to 22, where k is the coefficient accounting for the curvature of the model. Author (TAB)

N68-38027# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

HYPERSONIC INTERACTIONS NEAR SHARP LEADING EDGES

S. G. Rubin, T. C. Lin, M. Pierucci, and S. Rudman Jun. 1968 44 p refs
(Contract AF 49(638)-1623)
(PIBAL-68-17; AFOSR-68-1368; AD-674605) CFSTI: HC $3.00/MF $0.65

Numerical solutions of a set of parabolic equations, uniformly valid throughout the entire continuum flow domain, were obtained for the axi-symmetric flow over slender sharp nose cones at zero angle of attack, the hypersonic interference flow between two finite length flat plates and the flow over a sharp flat plate of finite span. The regions of interest are the leading edge merged layer and the initial portion of the strong interaction flow. The analysis represents an extension of the theory first used successfully for the flow over two-dimensional sharp flat plates. Merged layer interference, the merging of streams at different pressures in the wake of the channel geometry, the three-dimensional flow and shock structure, as well as the significant differences between two-dimensional, and axi-symmetric or three-dimensional flow fields are discussed. Comparisons with available experimental data are good, as evidenced by surface pressure and heat transfer results, for the flow over cones. Author (TAB)

N68-38033# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

APPLICATION OF THE BLUNT TRAILING EDGE BLADE CONCEPT TO LOW HUB TIP RATIO TRANSONIC SUPERSONIC COMPRESSORS Final Scientific Report, 1 Oct. 1966–31 Mar. 1968

Jacques Chauvin, Frans Breugelmans, and Hartmut Griepentrog 31 Mar. 1968 84 p refs
(Contract F61052-67-C-0018)
(VKI-IN-27; ARL-68-0110; AD-674628)

The report reviews cascade tests made on blunt trailing edge blades in the supersonic and subsonic ranges, as well as a paper study for a Mach 2, 0.5 hub to tip ratio supersonic rotor now being built. In the supersonic range, three bladings, corresponding to the mid section blading of existing rotors were tested. The tests show that care must be exercised when translating cascade data into rotor performance; satisfactory operation of the blunt trailing edge blading is obtained with Mach number as high as 1.7; longer passage and thinner blades lead to better performances. In the subsonic range, a loss correlation is proposed for partly slotted stator blades, indicating that slot effectiveness is a strong decreasing function of aspect ratio. The rotor paper design investigates the effect of axial inlet Mach number, enthalpy and entropy gradients, radius of curvature, contraction. A final design is obtained, which is described in detail. The report is concluded by a description of the R-4 compressor test rig being built to test rotor and stages of performance similar to the one of the rotor presented. Author (TAB)

N68-38057*# General Motors Corp., Indianapolis, Ind. Allison Div.

AXIAL FLOW COMPRESSOR DESIGN COMPUTER PROGRAMS INCORPORATING FULL RADIAL EQUILIBRIUM. PART 2: RADIAL DISTRIBUTION OF TOTAL PRESSURE AND FLOW PATH OR AXIAL VELOCITY RATIO SPECIFIED (PROGRAM 3)

H. F. Creveling and R. H. Carmody Jun. 1968 290 p refs
(Contract NAS3-7277)
(NASA-CR-54531; EDR-5897) CFSTI: $3.00 CSCL 01A

A computer programmed compressor aerodynamic design system is presented which accounts for full radial equilibrium of the flow, including streamline curvature and radial gradients in total enthalpy and entropy. It was desired that the design system have the capability of producing design information for given annulus geometry or, alternatively, computing annulus geometry along with aerodynamic design information. These capabilities are available as alternative options in the program. The resulting design-point computation is iterative, with efficiencies determined through the use of correlated blade element profile loss data and the loss associated with a normal shock in the blade passages, where appropriate. The program is written with buffer storage capacity for up to ten sets of profile loss parameter data, each set including hub, mean, and tip data for diffusion factor values between 0 and 1.0. These profile loss data sets are elected by the program user for any given design calculation from a master file of up to 999 profile loss parameter sets. In this program, energy addition is determined through specification of the profile of total pressure at each rotor exit, and through specification of limiting values on five aerodynamic parameters for each stage. These aerodynamic parameters are: (1) rotor tip diffusion factor, (2) stator hub diffusion factor, (3) stator hub Mach number, (4) rotor hub relative exit angle, and (5) rotor tip exit whirl velocity. Author

N68-38110# Aerospace Corp., El Segundo, Calif. Lab. Operations.

AERODYNAMIC FORCE MEASUREMENTS ON A SLENDER TWO-DIMENSIONAL WEDGE IN THE HYPERSONIC VISCOUS INTERACTION REGIME

L. Rosenman Jun. 1968 21 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-10)-12; SAMSO-TR-68-284; AD-674758)

Aerodynamic coefficients of a two-dimensional slender wedge were obtained from tests conducted in a hypersonic shock tunnel. Tests were performed with a three-component acceleration compensated force balance at nominal Mach numbers of 15.9 and 19.5, with free-stream Reynolds numbers (based on length) of 270,000 and 70,000, respectively. For this range of Mach number and Reynolds number, experimental lift results were in good agreement with predictions obtained from the theoretical development of Mirels and Lewellen; drag results tended to be in better agreement with Bertram. However, experimental values for maximum

lift-to-drag ratio were below values predicted by both theories by approximately 25 percent for M = 19.5 and 31 percent for M = 15.9. Author (TAB)

N68-38141# Bell Helicopter Co., Fort Worth, Tex.
WIND TUNNEL TESTS OF FULL-SCALE ROTORS OPERATING AT HIGH ADVANCING TIP MACH NUMBERS AND ADVANCE RATIOS Final Report
Watson H. Tanner and James F. van Wyckhouse Jul. 1968 150 p refs
(Contracts DA-44-177-AMC-291(T); DAAJ02-67-C-0018)
(USAAVLABS-TR-68-44; BELL-576-099-001; AD-674188)

Tested were: (1) production UH-1D (NACA 0012 profile) 48-foot-diameter blades, (2) modified UH-1D blades reduced in thickness at the tip, and (3) UH-1D blades reduced in diameter to 34 feet. The production blades were evaluated at Mach numbers up to 0.95, the thin-tipped blades to Mach 1.025, and the 34-foot rotor to advance ratios of 0.79. The production and thin-tipped blades are compared to show the compressibility effects. At higher tip Mach numbers, a significant reduction in power required was obtained with the thin-tipped blades. Additionally, the state of the art of calculating rotorcraft performance at high tip speeds and advance ratio is reviewed, and limited experimental data obtained with special boundary layer instrumentation installed at the 3/4 radius and surface pressure instrumentation installed near the blade tip are presented. Author (TAB)

N68-38212# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE FLOW STALL BOUNDARY IN COMPRESSOR VANE SYSTEMS [O GRANITSE SRYUA POTOKA V KOMPRESSORNYKH RESHETKAKH]
R. M. Fedorov 30 Aug. 1967 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR Energ. i Transp. (USSR), no. 4, 1965 p 91-97
(FTD-HT-67-187; AD-673943) CFSTI: HC $3.00/MF $0.65

The choice of parameters and the design of axial compressor stages are closely related to the determination of the critical angle of attack corresponding to the limit of disruptionless flow around compressor grids. Various researchers are trying to select the pertinent parameters and determine the discontinuity limits on the basis of the theory of the boundary layer. The paper discusses, on the basis of the analysis of the disruption condition (for a typical velocity distribution over the upper surface of the profile), the approximate solution of the problem of determination of the limit of disruptionless flow around plane compressor grids of differing densities and staggers. It is shown that the degree of attenuation of the flow along the upper surface of the profile may serve as the quantitative criterion of the flow discontinuity. The results of the calculations are in very good agreement with experimental data concerning the flows through compressor grids at low M numbers of the incident current. Author (TAB)

N68-38313# Hughes Tool Co., Culver City, Calif. Aircraft Div.
ROTOR/WING SERIES 6 WIND TUNNEL TEST 7-FOOT DIAMETER MODEL IN THE NASA LRC 30-BY-60-FOOT WIND TUNNEL
Frank J. Briardy and Robert E. Head Apr. 1968 213 p refs
(Contract Nonr-4588(00))
(HTC-AD-67-3; AD-673964)

Wind tunnel tests of a rotor/wing model were conducted for three purposes: To compare the results of testing the same model in a small and a large wind tunnel; to investigate rotor/wing planform effects on performance and flying qualities; to investigate in detail the low rotor speed range of conversion. The data gathered from testing the 7-foot diameter model in the 8-by-10-foot tunnel and in the 30-by-60-foot tunnel were in good agreement for rotor advance ratios greater than 0.15. Author (TAB)

N68-38340# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
AN EXPERIMENTAL STUDY OF THE PERFORMANCE AND STRUCTURAL LOADS OF A FULL-SCALE ROTOR AT EXTREME OPERATING CONDITIONS Final Report
Vincent M. Paglino and Andrew H. Logan Jul. 1968 268 p refs
(Contract DA-44-177-AMC-53(T))
(USAAVLABS-TR-68-3; SER-50505; AD-674187) CFSTI: HC $3.00/MF $0.65

Two sets of strain-gage instrumented full-scale rotor blades were tested in the NASA/Ames 40 feet x 80 feet Wind Tunnel. One blade set was a CH-34 rotor with -8 degrees twist while the second set had zero twist. Advance ratios to 1.05 and tip Mach numbers to 0.93 were tested over a wide range of collective pitch and shaft angle. Effects of twist, Mach number, and advance ratio on performance and stress are examined, as well as correlation of measured and predicted performance. Negative twist blades improved performance in all propulsive force modes. The zero twist blades had generally lower stresses with little or no performance penalty when rotor lift and propulsive force requirements were decreased. Predicted power rate of increase due to compressibility was somewhat greater than measured in the rotor propulsive mode. Blade vibratory stress and control loads increased sharply at high subsonic Mach numbers. Reductions in power and disc loading optimized lift-drag at high advance ratios, as predicted by theory, although drag calculations were low by 1 to 2 square feet of parasite area. At high advance ratio, blade stress increased primarily in the flapwise mode. The onset of stall is slower than predicted by theory and the inclusion of induced, boundary layer, and unsteady effects could improve performance prediction. Author (TAB)

N68-38360# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
NEAR WAKE OF A SLENDER CONE AT LARGE ANGLE OF ATTACK
E. M. Schmidt and Robert J. Cresci Jul. 1968 50 p refs
(Contract Nonr-839(38); ARPA Order-529)
(PIBAL-68-23; AD-673953)

The near wake of a sharp, slender cone at an angle of attack equal to the half-cone angle (10 deg) is studied experimentally. Tests were run at two different Reynolds numbers; these correspond to (1) completely laminar flow on the surface (Re = 150,000) and, (2) laminar flow on the windward and turbulent on the leeward surface (Re = 550,000). The nature of the surface boundary layer was determined by measuring the surface heat transfer over a wide range of test Reynolds numbers (60,000 < or = Re < or = 1,200,000) and comparing the data with theoretical analyses. Wake data obtained correspond to radial profiles taken in the plane of symmetry; total temperature, pitot, and static pressures are measured from the rear stagnation point to approximately seven diameters downstream of the base. Centerline distributions of Mach number, stagnation pressure, and static temperature are computed and compared to the corresponding results at zero angle of attack. Author (TAB)

N68-38430# Aeronautical Reserach Labs., Melbourne (Australia)
THE BEHAVIOUR AT SUBSONIC SPEEDS OF A MIRAGE III O PITOT-STATIC PROBE MOUNTED CLOSE TO A HYPERBOLIC HEADED GUST PROBE
N. Pollock May 1968 17 p refs
(ARL/A-300) CFSTI: HC $3.00/MF $0.65

In connection with a gust research project, tests were carried out in a transonic wind tunnel to determine the effect of mounting a gust measuring probe in close proximity to a Mirage III O pitot-static probe. The gust measuring probe which consisted of a 2-5/8 in. diameter cylindrical body with a hyperbolic head was mounted parallel to the Mirage probe at center line spacings of 10

in. and 14 in. The position of the head of the gust probe was varied between 0 in. and 7 in. aft of the nose of the pitot-static probe. The errors in the indicated total and static pressures were measured, for the various configurations tested, over a range of Mach numbers from 0.5 to 0.95 and at incidences of −5°, 0° and +10°. It was found that mounting the gust probe did not introduce any measurable error in the indicated total pressure. For the probe mounting configuration finally selected and for Mach numbers up to 0.9 the error in the pilot's instruments static pressure introduced a maximum indicated Mach number error of 0.012, a maximum indicated airspeed error of 8 knots, and a maximum indicated altitude error of 360 feet near ground level. Author

N68-38438# RAND Corp., Santa Monica, Calif.
HYPERSONIC SIMILARITY SOLUTIONS FOR AIRFOILS SUPPORTING EXPONENTIAL SHOCK WAVES
J. D. Cole and J. Aroesty Aug. 1968 52 p refs
(Contract F44620-67-C-0045)
(RM-5724-PR; AD-673998)

A study was made of airfoil optimization, using the equations of hypersonic gas dynamics to explore the Newtonian chine strip theory that airfoil concavity enhances the lift-to-drag ratio for a fixed drag penalty. The flow behind concave and convex exponential shock waves is investigated, and the corresponding airfoil surfaces are determined. The calculations show that the optimum lifting surface for fixed drag is only slightly more concave than a flat plate and that the improvement in performance is small. A limit line is shown to exist in the flow field behind convex exponential shock waves, so that is is not possible to construct a convex airfoil that supports an exponential shock wave over its entire length if the nose curvature is too large. Author (TAB)

N68-38473# ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL INVESTIGATION OF TWO BLUNT TRAILING EDGE SUPERSONIC COMPRESSOR ROTORS OF DIFFERENT BLADE THICKNESSES AND WITH CIRCULAR ARC CAMBER LINE
C. T. Carman, J. R. Myers, A. J. Wennerstrom (ARL) and John W. Steurer (ARL) Arnold Eng. Develop. Center Sep. 1968 61 p refs
(Contract F04600-69-C-0001)
(AEDC-TR-68-197; AD-674743) CFSTI: HC $3.00/MF $0.65

Two configurations of blunt-trailing-edge supersonic compressor blades were tested with air in a compressor rig. The performance of these blades was investigated over the speed range from 50 to 100 percent of design speed. The performance of the two blade configurations is compared, and the effect of the modifications between the two configurations is evaluated. Author (TAB)

N68-38483 Aix-Marseilles Univ. (France). Institut de Mecanique des Fluides de Marseille.
HYPERSONIC AERODYNAMIC FLOW AROUND SLENDER CIRCULAR CONES AT HIGH INCIDENCE, PART 1B [AERODYNAMIQUE HYPERSONIQUE ECOULEMENT AUTOUR D'UN CONE CIRCULAIRE MINCE A INCIDENCE ELEVEE, PARTIE 1B]
R. Brun and J. P. Guibergia 1968 27 p refs In FRENCH
(Contract DRME-67014)
CFSTI: $3.00

While wall heat flow measurements do not result in the exact and total configuration of the flow around a circular cone at incidence, they do provide a number of interesting points besides heat flow values. Containment of the flow in the case of low incidences, and appearance of separation on the convergence line and the same position as the generated separation boundary are noted. Surface heat flow in the symmetry plane of a circular cone at incidence is discussed as is the surface heat flow on the cone. The studies were made at high temperatures, at free hypersonic flow, and for a laminar boundary layer; and influence of separation at high incidence was investigated. Transl. by M.W.R.

N68-38487# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING LIFT OF A WING PROFILE AT INSTANTANEOUS CHANGE IN ANGLE OF ATTACK [OPREDELENIE PODEMNOI SILY PROFILYA KRYLA PRI MGNOVENNOM IZMENENII UGLA ATAKI]
A. A. Kosmodemyanskii 21 Sep. 1967 13 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. i Mekhan. (Moscow), v. 20, no. 5, 1965 p 52–60
(FTD-HT-67-427; AD-674159)

Formulas for the lift coefficient C sub y of an airfoil and its increase dC sub y/d(alpha) caused by a sudden change in the angle of attack alpha are derived by using the following model of lift generation in a plane-parallel flow: At the instant t = o, when alpha assumes instantaneously a new value alpha sub 1 > alpha, an initial Prandtl vortex leaves the sharp trailing edge of the airfoil. The circulation of this vortex increases with distance from the trailing edge, and at any instant t > o, the circulation must have such a value that the Zhukovskiy hypothesis (about the finite velocities at the points where the airstream leaves the trailing edge) will be fulfilled. The axis of this trailing-edge vortex can be visualized as a small-radius cylinder on which the boundary layer leaving the airfoil surface is wrapped, thus gradually increasing the circulation of the trailing vortex. The circulation of the boundary layer itself (per unit length) is considered as an infinitesimal quantity of the second order; the velocity field induced by the vortex layer is neglected. The problem is solved by using the methods of the theory of functions of a complex variable, assuming that at the instant t = o the lift equals zero. The formulas for C sub y and dC sub y/d(alpha) are presented in terms of a parameter tau = U sub infinity tcos alpha/4, where U sub infinity is the flow velocity at infinity. Author (TAB)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-37925# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TO QUESTION ABOUT SELECTION OF THE OPTIMUM THRUST-WEIGHT RATIO OF VTOL WITH RESPECT TO LIFT ENGINES [K VOPROSU O VYBORE OPTIMALNOI TYAGOVOORUZHENNOSTI AVVP PO PODEMNYM DVIGATELYAM]
O. K. Bogdanov et al 12 Dec. 1967 9 p Transl. into ENGLISH from Akad. Ukr. SSR Gidrodinamika Bol'shikh Skorostey, no. 3, 1967 p 114–118
(FTD-MT-24-358-67; AD-674680) CFSTI: HC $3.00/MF $0.65

An analysis is made of the problem of selecting the optimal thrust-weight ratio of lifting engines for vertical takeoff and landing aircraft, taking into account tactical, technical, and economic requirements. The article gives the results of computer calculations of transportation of cost and transport effectiveness as a function of the thrust-weight ratio of the lifting engine. Author (TAB)

N68-37932*# Southampton Univ. (England).
HELICOPTER NOISE--A BLADE SLAP. PART 1: REVIEW AND THEORETICAL STUDY
John W. Leverton Washington NASA Oct. 1968 58 p refs
(Grant NGR-52-025-002)
(NASA-CR-1221) CFSTI: HC$3.00/MF$0.65 CSCL 01C

This report reviews previous work on the topic of blade slap and the various mechanisms for its generation. It is concluded that blade/tip vortex interaction is the most likely noise producing mechanism. A theoretical approach to the problem leading to the development of a Blade Slap Factor (BSF), which will give an indication of the severity of blade slap likely on any helicopter, is also included. A comparison between some subjective assessments of the blade slap noise and the BSF is also given. Author

N68-37941*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TUNNEL INVESTIGATION OF AIRFRAME INSTALLATION EFFECTS ON UNDERWING ENGINE NACELLES AT MACH NUMBERS FROM 0.56 TO 1.46
Bernard J. Blaha and Daniel C. Mikkelson Washington Nov. 1968 83 p refs
(NASA-TM-X-1683) CFSTI: HC$3.00/MF$0.65 CSCL 01C

A 1/20 scale model of the F-106B with simulated underwing engine nacelles was tested in the 8- by 6-foot supersonic wind tunnel. Pressures and boattail drag coefficients were obtained on cone-cylinder and bulged nacelles with 15° conical boattail afterbodies and jet boundary simulators. Data were obtained with and without inlet airflow through the nacelles at attack angles from 0° to 8°. Effects of nacelle strut geometry, local elevon geometry, and elevon deflection were also investigated. The installed boattail pressure drag coefficient was lower than isolated nacelle values at all Mach numbers, and transonic drag rise was delayed to Mach 0.975. Author

N68-38062# Lockheed-California Co., Burbank.
IN FLIGHT MEASUREMENT AND CORRELATION WITH THEORY OF BLADE AIRLOADS AND RESPONSES ON THE XH-51A COMPOUND HELICOPTER ROTOR. VOLUME 2: MEASUREMENT AND DATA REDUCTION OF AIRLOADS AND STRUCTURAL LOADS, APPENDICES 5-9 Technical Report, Jun. 1966-Oct. 1967
E. A. Bartsch May 1968 454 p refs
(Contract DA-44-177-AMC-357(T))
(LR-21072, V. 2; USAAVLABS-TR-68-22B; AD-674194) CFSTI: HC$3.00/MF$0.65

Contents: Differential pressure -- dynamic components; Differential pressure -- static components; Blade loads -- dynamic and static components; Harmonic components of airloads and pitching moments; Harmonic components of structural loads. TAB

N68-38121# Lockheed-California Co., Burbank.
IN FLIGHT MEASUREMENT AND CORRELATION WITH THEORY OF BLADE AIRLOADS AND RESPONSES ON THE XH-51A COMPOUND HELICOPTER ROTOR. VOLUME 3: THEORETICAL PREDICTION OF AIRLOADS AND STRUCTURAL LOADS AND CORRELATION WITH FLIGHT TEST MEASUREMENTS Technical Report, Jun. 1966-Oct. 1967
J. E. Sweers May 1968 141 p refs
(Contract DA-44-177-AMC-357(T))
(LR-21072, V. 3; USAAVLABS-TR-68-22C; AD-674195) CFSTI: HC$3.00/MF$0.65

In most of the conditions analyzed, the computed bending moments were found to be in good agreement with the measured moments. The agreement between computed and measured torsion moments, however, was poor, indicating that improvements are required in the mathematical model as far as the torsional properties are concerned. (These may include the introduction of the control system degrees of freedom in the model.) Comparison of measurements with airloads obtained with the Cornell program shows good agreement of the variations of the airloads over the azimuth. At the lower forward speeds the rotor wake can be represented by a set of ring vortexes. An urgent need exists for a method for predicting wake deformation and for programming this method. Torsional responses are important in the computation of airloads. A rotor trim procedure included in a rotor loads program has been shown to be useful in the prediction of rotor loads. Based on the results obtained for chordwise bending moments, the relationship between normal force coefficient and chord force coefficient used in Lockheed Program I should be reexamined, particularly in high angle-of-attack areas. Such investigation may result in improved estimates of drag coefficients. Author (TAB)

N68-38180# Lockheed-California Co., Burbank.
IN-FLIGHT MEASUREMENT AND CORRELATION WITH THEORY OF BLADE AIR LOADS AND RESPONSES ON THE XH-51A COMPOUND HELICOPTER ROTOR. VOLUME 1: MEASUREMENT AND DATA REDUCTION OF AIRLOADS AND STRUCTURAL LOADS Technical Report, Jan. 1966-Oct. 1967
May 1968 179 p refs
(Contract DA-44-177-AMC-357(T))
(IR-21072, v. 1; USAAVLABS-TR-68-22A; AD-674193) CFSTI: HC$3.00/MF$0.65

The report presents the results of a two-phase research program consisting of (1) in-flight measurement of aerodynamic pressures and structural loads on a compound, rigid-rotor helicopter and (2) correlation of these data with theoretical results. Flight test data obtained in Phase I and recorded on an oscillograph were read on an oscillograph reading machine and were processed in an automatic data reduction program. This data processing consisted of integration of the pressure data to obtain the distribution of aerodynamic lift and pitching moments over the rotor blade, as functions of azimuth position. Airload and structural load data were harmonically analyzed. Output of the data reduction program was used in Phase II as input to the correlation program. The measured airloads were used to compute the theoretical bending and torsion responses of the blade. The measured torsion moments were used in the theoretical prediction of the airloads. The results of the applied theories are compared with the flight measurements. Author (TAB)

N68-38272# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WINTER-LANDING UNDER CONDITIONS OF ICE-FORMATION [ZIMA, POSADKA V USLOVIYAKH OBLEDENENIYA]
O. Trunov 2 Nov. 1967 10 p Transl. into ENGLISH from Aviatsiya i Priroda
(FTD-HT-23-643-67; AD-674335) CFSTI: HC $3.00/MF $0.65

The reasons are given for dealing with the prelanding pattern of turbojet and turboprop aircraft in winter. The different ice forms are described as well as where they are formed and their effect on the stability. The effects of the load factor and the speed are dealt with. Further discussed are the problems of the effectiveness of the deicing system, the kind of flight (whether horizontal, descending, or ascending), the utilization of the power plant, the timeliness of switching on of the system, the effect on the control stick, etc. Author (TAB)

N68-38279# Kaman Aircraft Corp., Bloomfield, Conn.
APPLICATION OF DIRECTED GLASS FIBER REINFORCED PLASTIC TO HELICOPTER TAIL ROTOR ASSEMBLY
Paul F. Maloney, Frank B. Clark, and Hugh H. Mc Intyre Ft. Eustis, Va. Army Aviation Mater. Labs. Jun. 1968 73 p
(Contract DA-44-177-AMC-306(T))
(R-717; USAAVLABS-TR-68-29; AD-674252) CFSTI: HC $3.00/MF $0.65

An engineering program was conducted for the purpose of investigating the feasibility of a new rotor concept utilizing a monolithic spar of directed glass fibers supported in an epoxy matrix. This concept makes use of the anisotropic property of the material to eliminate pitch bearings and thereby reduce maintenance requirements. The program included design, fabrication development, analysis and test phases. The latter two phases were of limited scope since the intent of the program was a basic feasibility investigation. The rotor has satisfactorily completed all phases including a 25-hour whirl test. It was concluded that rotors of this general configuration are practical, offer significant advantages, and can be fabricated in a production environment. Author (TAB)

N68-38280# United Aircraft Corp., Startford, Conn. Sikorsky Aircraft Div.
A STUDY OF HANDLING QUALITIES REQUIREMENTS OF WINGED HELICOPTERS
W. Sardanowsky and H. P. Harper Ft. Eustis, Va. Army Aviation Mater. Labs. Jul. 1968 97 p refs
(Contract DA-44-177-AMC-382(T))
(SER-50489; USAAVLABS-TR-68-39; AD-674251) CFSTI: HC $3.00/MF $0.65

A study was conducted to establish a basis for the mission task performance oriented approach to flying and handling qualities specification. Interviews with Army personnel were used to determine typical Army missions, the related critical mission tasks, and task performance tolerances. To complete step 2, a list of items, applicable to winged helicopters, from MIL-H-8501A, MIL-F-8785, AGARD TR-408, and USAAVLABS TR 65-45 was compiled, and tabulated according to the specifications format proposed in the study. Flight test data were to be used to establish the relationship between design parameters and flying qualities. However, unavailability of data precluded the determination of the relationship between flying and handling qualities and design parameters. Author (TAB)

N68-38332# Dynascience Corp., Blue Bell, Pa.
INVESTIGATION OF THE DOWNWASH ENVIRONMENT GENERATED BY V/STOL AIRCRAFT OPERATING IN GROUND EFFECT
M. George, E. Kisielowski, and D. S. Douglas Jul. 1968 149 p refs
(Contract DA-44-177-AMC-316(T))
(DCR-275; USAAVLABS-TR-68-52; AD-674644) CFSTI: HC $3.00/MF $0.65

Analytical methods are developed for determining the downwash environment generated by multirotor/propeller V/STOL aircraft configurations operating in ground proximity. These methods are utilized to compute rotor flow field and contaminant dust cloud characteristics (including particle density and size distributions) for the H-21, XC-142, X-22A, X-19A, and XV-5A aircraft. The effects of the contaminated atmosphere on pilots visibility, ground equipment, and personnel are also determined for these aircraft. The theoretically predicted results are generally in good agreement with the limited test data. Additional full-scale test data are required to verify further the assumptions inherent in the theory. Author (TAB)

N68-38470# Directorate of Aerospace Safety, Norton AFB, Calif. Life Sciences Div.
SURVIVAL FOLLOWING AIR FORCE AIRCRAFT ACCIDENTS
William R. Detrick and Anchard F. Zeller 1968 61 p refs
(AD-674002)

Survival accidents for the six year period 1958 through 1963 were evaluated. A survival situation was defined as any situation on water and any situation on land resulting in delay in rescue of one hour or more. Approximately 10% of all Air Force Major Accidents resulted in a survival situation. Author (TAB)

N68-38491# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
FEASIBILITY STUDY OF A HYBRID VIBRATION ISOLATION SYSTEM Final Report
David Alan Bies Aug. 1968 52 p
(Contract DAAJ02-67-C-0082)
(USAAVLABS-TR-68-52; Rept.-1620; AD-674213) CFSTI: HC $3.00/MF $0.65

The fluctuating lift of a helicopter rotor gives rise to undesirable vibration over a broad frequency range which in some cases may extend to as low as 3 Hz. Vibration isolation over this frequency range is very difficult to achieve with either a purely passive or an active vibration isolation system. A passive system will work well at high frequencies, but it will always have a low-frequency resonance where excitation will be amplified rather than reduced. An active system may work well at low frequencies, but it will have trouble meeting the frequency response requirements at high frequencies. The investigation of the feasibility of combining an active and a passive system was conducted to gain the advantages of both. The report shows that an active system may be used to control the resonant response of a passive system while preserving the isolation achieved at high frequencies. Isolation over a broad frequency range may be obtained by this means with only a small amplification of response at low frequencies. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-37438# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DESIGN STUDY ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS Final Report, 1 Sep. 1966–29 Feb. 1968
A. E. King, ed. 1 Feb. 1968 240 p 35 refs
(Contract AT(04-3)-679)
(SAN-679-8) CFSTI: HC $3.00/MF $0.65

Analytical conceptual designs are presented for purposes of illustrating recent technology for electrical power system components in advanced high-temperature, potassium, Rankine nuclear space power systems in the 0.25 to 10 megawatt range. Data presented are based on extensive backgrounds in the development of high temperature electrical materials, high temperature ac generators and motors, and power conditioning equipment for space application and is intended for application in future nuclear-electric powerplant system or mission studies. Since requirements of the electrical power systems are related to the missions, the design studies were carried out using three

representative missions: interplanetary, orbital and planetary base. These were analyzed for the purpose of defining the ranges and types of electrical power needs and corresponding components. Author (NSA)

N68-37497 Duke Univ., Durham, N. C.
STUDY OF A RECIPROCATING ELECTROMECHANICAL TRANSDUCER
Joseph Marvin Hunt, III (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3430

An investigation of a modified free-piston engine to operate and be combined with a generator to transfer power from chemical to electrical form was conducted. An experimental model for the free-piston engine was constructed and a mathematical model developed based on well known physical principles. The performance of the experimental model was compared with the theoretical results. The free-piston engine was combined with a nonlinear electrical circuit both in the laboratory and on the computer to examine a resonance effect. The mathematical model of the free-piston engine and a linear generator were combined to show that an engine generator combination to transform practical amounts of power was possible. Dissert. Abstr.

N68-37510 Duke Univ., Durham, N. C.
A STUDY OF THE VOLTAGE STEP-DOWN DC-TO-DC REGULATED CONVERTER WITH HYSTERETIC BISTABLE TRIGGER—ANALYSIS WITH EMPHASIS ON DESIGN
Ihsan M. H. Babaa (Ph.D. Thesis) 1967 165 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-3413

A general theory of the operating properties of a voltage step-down regulated dc-to-dc converter has been developed. Output-voltage regulation is accomplished by properly modulating the switching of the power transistor between the dc source and a second-order LC output filter. A bistable trigger circuit with hysteresis is used for this purpose. This circuit senses the level of the voltage at the output of the filter, so that the actual output voltage across the load terminals is regulated. Piecewise-linear models for nonlinear semiconductor circuit elements are used in the analysis. Differential equations of second order are derived for the error in the out-voltage level measured with respect to a known reference. Static and dynamic converter behavior is studied under arbitrary conditions of circuit parameters, input voltage, and load. All formulations of the converter properties in terms of its circuit parameters are in the form of relatively simple and easy-to-interpret expressions. Dissert. Abstr.

N68-37637# Aerojet-General Corp., Azusa, Calif.
EXPLORATORY RESEARCH ON JET-CONDENSER PERFORMANCE WITH ORGANIC RANKINE-CYCLE POWER SYSTEMS
R. Garcia 19 Dec. 1967 111 p 3 refs
(Contract AT(04-3)-728)
(AGC-3484) CFSTI: HC $3.00/MF $0.65

The design and performance of a jet-condenser for a 1 to 15 kW(e) organic Rankine-cycle power conversion system for turbine exhaust pressures of 0.5 to 0.1 psia are described. The purpose is to design a jet-condenser compatible with zero-gravity space environment. The jet-condenser condenses the saturated vapor with subcooled liquid which ensures single-phase flow through a radiator. Mathematical analysis and design and fabrication of experimental units are included. NSA

N68-37689*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Central Lab Semiconductor Div.
STUDY OF LITHIUM DOPED SOLAR CELLS
Peter A. Iles 15 Aug. 1968 18 p Prepared for JPL
(Contracts NAS7-100; JPL-952250)
(NASA-CR-97344; Rept.-4; QR-4) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Work concentrated on various methods for introducing lithium into solar cells, and on the solar cell properties resulting from the lithium distribution. The spread of the cell photovoltaic output, and typical lithium distributions are included. Author

N68-37748*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SKY EFFECT ON SOLAR CELLS CALIBRATED AT 80,000 FEET
Donald W. Ritchie 15 Oct. 1968 14 p 5 refs
(Contract NAS7-100)
(NASA-CR-97348; JPL-TR-32-1313) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The use of high-altitude balloon flights for the calibration of standard solar cells has been proven to be a reliable method of obtaining space-calibrated solar cells for terrestrial and laboratory measurements. A technique is presented to help further refine these methods by determining the percentage of sky radiation incident on solar cells during the balloon cell calibration. It was found that the contributions of sky radiation to the output of solar cells at 80,000 feet were less than 0.5%. Author

N68-37750*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF RADIATION EFFECTS IN Li DOPED SILICON SOLAR CELLS Quarterly Report
J. R. Carter, R. E. Scott, and R. G. Downing 15 Aug. 1968 13 p
(Contract JPL-952251)
(NASA-CR-97321; TRW-10971-6005-R0-00; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

This report covers the initial three months of effort concerning radiation effects in Li-doped silicon. Initial efforts utilizing $LiAlH_4$ as a diffusion source are promising, but to date have failed to yield surface lithium concentrations in excess of 10^{17} atoms/cm^3. Lang x-ray topography has been attempted to determine whether lithium instabilities at higher temperatures are due to precipitation, outdiffusion, or some other mechanism. Results to date indicate that lithium precipitation producing strained regions greater than 0.1 mm are not observed. Removal rate studies indicate exponential carrier removal as a function of electron fluence in Li-doped float-zone silicon, but a linear dependence on electron fluence in crucible grown silicon. Finally, isochronal annealing studies indicate a variety of material dependent effects including relatively low temperature annealing stages and reverse annealing stages. Sufficient data on these annealing phenomena have not yet been obtained to determine their dependence on material parameters. Author

N68-37832*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR CELL RADIATION DAMAGE ON SYNCHRONOUS SATELLITE ATS-1
Ramond C. Waddel Oct. 1968 22 p 14 refs
(NASA-TM-X-63379; X-710-68-408) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Various types of solar cells were monitored during 416.8 days in synchronous orbit on satellite ATS-I. Judging by the remaining percentage of initial maximum power qualified conclusions were: (1) degradation was greater than expected; (2) optimum base resistivity was 10 ohm-cm; (3) optimum shield thickness was 6 mils; (4) sapphire and silica shields were comparable; (5) silica shields were superior to glass; (6) boron and aluminum doping

were comparable; (7) that it was necessary to presume some radiation damage, some drop in illumination, and a development of series resistance to account for the results. Author

N68-37834*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
DEVELOPMENT AND TESTING OF A FIVE AH SILVER-ZINC CELL Summary Report, Jul. 1967–Jun. 1968
A. Himy Jul. 1968 142 p 4 refs
(Contract NAS3-10924)
(NASA-CR-72445; DAC-60521-S1) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Based on previous studies which showed that a silver-zinc cell designed with the Douglas inorganic separator 3420-09 (rigid type) is capable of improved cycle life at temperatures as high as 100°C, a program was initiated in an attempt to refine 5-Ah cell design suitable for extensive characterization. Reported are results of studies focusing on the selection of improved cell components, and the testing of the cell design incorporating all the improvements. Improvements to the silver electrode, the separator, the case material, the ultrasonic weld technique, the electrolyte concentration, and separator edge seals were made. All of these features were incorporated in the final cell design which was submitted to selected tests for final approval. Wet stand tests were satisfactory over three months. The environmental tests (shock, acceleration, and vibration) showed no detrimental effect on the charged cells. The electrical tests run on a severe regime gave good results considering the high rates imposed on charge and discharge on a cell intended for a low rate application. S.C.W.

N68-37935*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON BETWEEN CEMENTED AND SOLDERED COVERGLASS FOR SILICON SOLAR CELLS
Jacob D. Broder Washington Nov. 1968 11 p refs
(NASA-TM-X-1687) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A comparison was made of the spectral response of cemented and soldered cover glass on a current commercial silicon solar cell. Cover glass transmission factors were determined in the range of 0.4 to 0.95 micron with a filter-wheel solar simulator. Soldered and cemented cell short circuit current spectral response was calculated as a function of the effectiveness of the cover-glass radiation protection, for a bombardment dose of 10^{16} 1-MeV electrons per square centimeter. Author

N68-37943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF A 5-INCH SINGLE-STAGE AXIAL-FLOW TURBINE DESIGNED FOR A BRAYTON CYCLE SPACE POWER SYSTEM
Donald E. Holeski and Samuel M. Futral, Jr. Washington Nov. 1968 22 p refs
(NASA-TM-X-1666) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The turbine investigated was designed to drive a six stage, axial flow compressor for a 10-kilowatt, two shaft space power system. Tests were made using argon at an inlet pressure of 2.9 psia (2.0 N/cm^2 abs) and an inlet temperature of 582°R (323 K). Test results showed that the turbine efficiency was below the design value. Data indicated the rotor tip sections performed poorly. The exit diffuser performed well. Author

N68-38001*# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
THERMIONIC CATHODE EVALUATION STUDY Annual Report, 1 Jan. 1967–Mar. 1968
F. T. Hill 12 Apr. 1968 64 p Prepared for JPL
(Contracts NAS7-100; JPL-951810)
(NASA-CR-97322; Pt-1846; AR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A study was conducted of the dc life capabilities of three different cathode types. A life test diode has been designed and tested for conformance with the required cathode current densities. A 48-position life test station was designed, constructed and tested for use in this program. One hundred twenty-six test diodes with pore-type dispenser, standard barium strontium oxide, and coated particle cathodes were fabricated for use in this study. Sixteen diodes using pore-type dispenser cathodes have completed at least 4700 hours of life burning satisfactorily at temperatures ranging from 950°C to 1100°C with cathode current from 0.2 A/cm^2 to 1.6 A/cm^2. Sixteen diodes using standard barium strontium oxide cathodes have completed life burning in times ranging from 1371 to 3439 hours. The diodes are showing cathode emission slump at current densities above 0.15 A/cm^2 and temperatures ranging from 800°C to 850°C and cathode currents from 0.075 A/cm^2 to 0.6 A/cm^2. The coated-particle cathodes show the capability of being operated up to 0.55 A/cm^2 at 900°C. Further tests with higher current levels above 0.55 A/cm^2 show unexpected inhibited emission in comparison to pulsed emission. Author

N68-38064# Leesona Corp., Great Neck, N. Y. Leesona Moos Labs.
HIGH RATE PRIMARY ZINC/AIR BATTERY Quarterly Report, 15 May–15 Aug. 1967
Emanuel G. Katsoulis, Bernard Randall, and Sheldon Cohen Jul. 1968 54 p refs
(Contract DAAB07-67-C-0432)
(ECOM-0432-1; QR-1; AD-674771) CFSTI: HC $3.00/MF $0.65

A system study of the high rate throwaway battery determined that thick anodes discharged to high efficiency were necessary for high energy density and minimum cost. Laboratory investigation indicated that .250 inch zinc anodes operating at 43 mA/sq cm could attain greater than 70% discharge efficiency. Furthermore, it was demonstrated that high discharge efficiencies could be attained with dendritic zinc and commercially available zinc powders as well as reduced zinc oxide. An intensive materials and processing cost reduction investigation was initiated. The largest cost saving demonstrated was the substitution of copper for the silver anode current collector. Elimination of vacuum drying by dry pressing the anodes was also shown feasible. Cathode cost reductions also showed promise. Preliminary designs gave an estimated energy density of 85 watt-hours/lb. System studies projected no heat rejection or dry-out problems during normal operation. Author (TAB)

N68-38071# Office of Naval Intelligence, Washington, D. C. Translation Div.
THE NICKEL SKELETAL CATALYST BASED HYDROGEN ELECTRODE AND HOW IT WORKS [K MEKHANIZMU RABOTY VODORODNOGO ELEKTRODA NA OSNOVE NIKELEVOGO SKELETNOGO KATALIZATORA]
R. Kh. Burshtein, A. G. Pshenichnikov, F. Z. Sabirov, and V. N. Zhuravleva 10 Jun. 1968 11 p refs Transl. into ENGLISH from Elektrokhim. (USSR), v. 4, no. 1, 1968 p 13–19
(NIC-TRANS-2617; AD-674820)

The manner in which a porous gas electrode, activated by a skeletal catalyst, works is reviewed. The electrochemical activity in accordance with the composition of the active mixture and the thickness of active and barrier layers is studied. Author (TAB)

N68-38074# Bell Helicopter Co., Fort Worth, Tex.
FLIGHT TEST OF A HONEYWELL, INC., FLUIDIC YAW DAMPER Final Report
John C. Kidwell Ft. Eustis, Va. Army Aviation Mater. Labs. Jul. 1968 50 p refs
(Contract DAAJ02-67-C-0057)
(USAAVLABS-TR-68-53; AD-674211) CFSTI: HC $3.00/MF $0.65

Flight tests were conducted to evaluate the performance and feasibility of a fluidic yaw damper system. A standard UH-1C helicopter was used as a test vehicle. Author (TAB)

N68-38088*# Syracuse Univ. Research Inst., N. Y. Dept. of Mechanical and Aerospace Engineering
NOISE GENERATION BY HIGH-SPEED AXISYMMETRIC JET FLOWS INTERACTED WITH RADIALLY IMPINGING ANNULAR JET FLOWS Final Report
Francis J. Montegani and Darshan S. Dosanjh Dec. 1967 178 p refs
(Grants NsG-431; NSF GP-1137)
(NASA-CR-66706; SUIR-1620.1085) CFSTI: HC $3.00/MF $0.65 CSCL 20A

Supersonic jet noise investigations were conducted using the impingement of a radial annular jet flow on the first shock-cell region of a moderately underexpanded axisymmetric converging main jet flow. A characteristic variation of the total acoustic power level with the amount of impinging flow was observed. Under certain operating conditions the total acoustic power emitted by the interacted jet flows was lower than that emitted by the main jet flow alone. A maximum sound pressure level reduction of 3 1/2 dB was achieved. The observed variations in noise level were accompanied by characteristic variations of the shock pattern of the interacted jet flows. The emergence of new repetitive shock structure interposed between the original repetitive shock pattern of the main jet flow was observed. The shadowgraphs also revealed an apparently spherical acoustic emission originating at each oblique shock tip. An acoustic model of the flow is proposed as a distribution of wideband acoustic monopole sources on a line, which correspond to the apparent sources at each oblique shock-end. Author

N68-38113*# TRW Systems Group, Redondo Beach, Calif.
STUDY TO ESTABLISH CRITERIA FOR A SOLAR CELL ARRAY FOR USE AS A PRIMARY POWER SOURCE FOR A LUNAR-BASED WATER ELECTROLYSIS SYSTEM Monthly Progress Report, 1 Jul.–31 Aug. 1967
J. E. Boretz 15 Sep. 1967 9 p
(Contract NAS8-21189)
(NASA-CR-98023; TRW-7440-73; MPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Preliminary technical plans and investigations are outlined. Decisions are reported to emphasize first the design, deployment, and orientation of large solar arrays and the associated requirements. Initial discussions on the electrolytic reactants production system and coordination of its power requirements with the solar array are outlined. Basic data is given on the 2 kw alkaline fuel cell, and tradeoff studies on solar array configurations and power systems are reported. Surveys are mentioned to obtain data on lunar surface environment and solar array materials. N.E.N.

N68-38133# Eagle-Picher Co., Joplin, Mo.
VENTED NICKEL-CADMIUM BATTERY ASSEMBLY BB-607()/U Final Report, 23 Jun. 1966–30 Jul. 1967
Earl S. Carr Jul. 1968 110 p
(Contract DA-28-043-AMC-02512(E))
(ECOM-02512-F; Rept.-1; AD-674228) CFSTI: HC $3.00/MF $0.65

The purpose of the contract was the design, development and testing of the nickel cadmium battery assembly BB-607()/U. This battery assembly is a military-ruggedized design consisting of two tiers of BB-616()/U batteries stacked one above the other in the man-pack configuration. The battery assembly is rated at 24 volts and 5.5 ampere-hours or 12 volts and 11 ampere-hours. Twenty-one battery assemblies were constructed and 16 were successfully tested to environmental and electrical testing. The environmental tests included vibration, bounce and 4 in. drop testing of all corners, faces and edges with cover and simulated equipment. In addition to these tests, 19 BB-616()/U batteries were subjected to a complete range of environmental and electrical tests. The report outlines the design and development program and fully documents the battery assembly design. Complete drawings to USAECOM format are included, as well as artists visualization of the battery assembly. TAB

N68-38209*# Exotech, Inc., Washington, D. C.
EFFECTS OF UNIFORM DAMAGE TO SILICON SOLAR CELLS
M. J. Barrett and R. H. Stroud 10 Oct. 1968 30 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952246)
(NASA-CR-97418; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A theoretical analysis of published data on silicon solar cells has been performed. Reasonable values of the photovoltaic current density at the cell junction have been obtained as a function of the minority carrier diffusion length L in the base region. The calculation was performed on a computer with a numerical technique which appears applicable to a nonuniform profile of L across the base region, as occurs after low-energy proton damage. The junction characteristics of the cells were also shown to be affected by radiation, light and temperature in ways that can be described by simple mathematical functions. Author

N68-38221# Harry Diamond Labs., Washington, D. C.
THE THERMAL REACTION BATTERY. 3. PREPARATION AND PYROLYSIS OF SOME ALIPHATIC HYDRAZONIUM SALTS
Elizabeth L. Anderson Jul. 1968 24 p refs
(HDL-TR-1400; AD-674183)

Salts of aliphatic aldehyde hydrazones have been prepared for evaluation as solvents for inorganic electrolytes in a proposed thermal reaction battery. This work comprises an extension of related work with aromatic hydrazonium salts. The aliphatic salts should yield polar products of superior solvent ability. Preliminary data indicate that the aliphatic salts prepared decompose near 200C to yield a predominance of the desired polar products. Problems with instability of the starting material and sensitivity of the product to moisture were encountered. A series of hydrazonium salts containing varied anions will be prepared in an effort to reduce moisture sensitivity. Instability of the starting material will be circumvented by a new preparative scheme which should yield a series of dihydrazonium salts. Author (TAB)

N68-38282# Leesona Corp., Great Neck, N. Y. Leesona Moos Lab.
HIGH RATE PRIMARY ZINC/AIR BATTERY Quarterly Report, 16 Aug.–15 Nov. 1967
Emmanuel G. Katsoulis and Bernard Randall Sep. 1968 42 p
(Contract DAAB07-67-C-0432)
(ECOM-0432-2; QR-2; Rept.-2; AD-674229) CFSTI: HC $3.00/MF $0.65

The materials and processing costs of the cathode for the high rate primary battery were investigated to achieve an effective cost reduction while still maintaining performance and reliability.

Concurrent with this investigation, development of both paste and pressed powder anodes centered on the uses of New Jersey powder no. 1222. It was determined that this zinc powder, when combined with inert fillers, was more desirable than reduced zinc oxide/dendritic zinc powder combinations from the standpoint of handling, processing and cost considerations. Work was carried out on the optimization of techniques used in the fabrication of anodes and the investigation of various inert filler materials. Laboratory results have shown that either the pressed or paste anodes can meet the capacity requirements specified for this program. The final choice of anode type will depend on: (1) capacity achieved in multicell testing; (2) ability to be stored at high temperatures; (3) adaptability to automated production and (4) to a bicell design that can be automatically assembled. An improved test cell to be used for anode and cathode evaluation was designed and fabricated. Author (TAB)

N68-38356# Harry Diamond Labs., Washington, D. C.
RATES OF ELECTROLYTE FLOW THROUGH THE LEVELING HOLE OF A SPINNING AQUEOUS BATTERY
Fernando Villarroel Jul. 1968 20 p
(HDL-TM-68-22; AD-674181)

The differential pressure across the leveling hole in the liquid reserve battery was derived as a function of spin rate n, liquid density RHO, and the inner radii of the liquid level of adjacent cells connected by the leveling hole and is related to flow by a mathematical equation. Author (TAB)

N68-38424# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
FLUIDIC RELIABILITY Final Report, 21 Dec. 1966–15 Jan. 1968
Harvey Ogren, Eugene Peterson, and Darroll Bengston Jun. 1968 144 p refs
(Contract DAAJ02-67-C-0003)
(USAAVLABS-TR-68-36; Rept.-20810-FRI; AD-674222)

The objective of this contract was to develop quantitative information concerning the reliability and maintainability of hydraulic fluidic components and systems. This was accomplished by testing a feasibility-model hydraulic single-axis stability augmentation system (SAS) under conditions simulating actual flights of a UH-1B helicopter and, along with 15 of each type of component making up the SAS, life testing under environmental conditions of 0.5-g and 2.0-g vibration, temperature from -30F to +200F, and cycling of the component input signals. Also tested were 15 bistable amplifiers. The components were divided into environmental and nonenvironmental groups, with the environmental group divided into groups subject to 50-micron oil and 10-micron oil. This made up the 15 components, five in each of the three groups. The feasibility SAS and the components making up the SAS completed the testing with no failures. While the bistable amplifiers did not meet the failure limits, they still had enough gain to switch another like amplifier. The results of this program show that fluidic components and systems are very reliable. Since fluidic components appear to fail only in a wearout mode, more components should be tested for longer periods of time to determine their life and how they fail. Author (TAB)

N68-38456# Leesona Corp., Great Neck, N. Y.
DEVELOPMENT OF ZINC/AIR 24 VOLT, 48 AMPERE-HOUR STANDARD LINE BATTERY SYSTEM Final Report, 15 Jun. 1967–29 Feb. 1968
P. Noorily and F. Staudinger Aug. 1968 49 p
(Contract DA-28-043-AMC-02082(E))
(ECOM-02082-F; AD-674212) CFSTI: HC $3.00/MF $0.65

The report covers the work performed toward the development of a 48 ampere-hour zinc/air battery system conforming to the Electronics Command Technical Requirement SCL 6895 amendment 1 dated April 20, 1967. This requirement called for the development of a versatile battery system capable of delivering 48 ampere-hours within a weight restriction of 15 pounds and conforming to the standard line battery cross section. The standard line battery cross section (length 12 in, width 4 in, height 9 in) represents a size designation for a new military family of batteries. Batteries have been designed, fabricated and tested. The battery weight is 14.8 pounds and the system has a maximum current capability of 10 amperes. This system has been tested on three duty cycles at various ambient temperatures (0F, 70F and 125F). These tests have indicated that full capacity can be obtained at room temperature on a battery having up to 150 hours of operation. Repeated cycling of the battery beyond this point results in an increased loss of water evaporation from the cells and a lowering of the electrochemical performance. This loss of water can be replenished by a simple water addition to all cells and full capacity is obtained. Re-addition of water also has the advantage that full capacity can be delivered at the high temperature point (+125F). Life studies have been performed at LML and indicate that a battery life in excess of 600 hours is obtainable at the present time. Author (TAB)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-37698*# Naval Aerospace Medical Inst., Pensacola, Fla.
EFFECT OF DRUGS ON OCULAR COUNTERROLLING
Earl F. Miller, II and Ashton Graybiel 5 Aug. 1968 19 p 16 refs
(NAMI-1046) CFSTI: HC $3.00/MF $0.65 CSCL 06O

To determine the temporal effect of each of several selected drugs and a placebo upon ocular counterrolling, a specific indicator of otolith activity, measurements under controlled conditions were made before and at various times after the oral administration of the drug or placebo. Nine normal subjects participated, and from four to six were used in each experimental trial. Alcohol, 1 cc/lb body weight, had a marked and progressive depressant effect on the amount of eye roll during the intoxication period; complete recovery was recorded six hours after its ingestion. Scopolamine, meclizine, acetylsalicylic acid, meprobamate, chlordiazepoxide hydrochloride, d-amphetamine, and diphenidol, given in twice the usually recommended doses, had little or no effect. Author

N68-37722*# General Technical Services, Inc., Philadelphia, Pa.
A STUDY OF THE GENERAL DYNAMICS OF THE PHYSICAL-CHEMICAL SYSTEMS IN MAMMALS Final Report
Arthur S. Iberall Oct. 1968 31 p 27 refs
(Contract NASw-1066)
(NASA-CR-97316) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Reported are results of studies of dynamic aspects of thermoregulation, cardiovascular system hydrodynamics, dynamic regulation in physiological systems, hormonal regulation, and behavior in mammals. One major idea that was the keynote of these studies was that homeostatic control in the biological system originates from dynamic regulation in which the stability of nonlinear chains of near-relaxation oscillatory types is mediated near the boundary between aperiodic and periodic instability. These studies were undertaken in an attempt to explain temperature regulation starting at the level of the microcirculation where the monitoring of oxygen supplies to tissue and the governing of heat production takes place; overall control and transmission characteristics in the cardiovascular system; hormonal regulation through interactions of

the products of the endocrine system with regulated parameters and blood constituents, and in the behavioral system for consistency of orienting physical views of the dynamics of a complex computer control network with psychological and physiological overtones. Although the overall program was concerned with the theoretical treatment of such pertinent biological data as in the literature, an attempt was made to develop new data consonant with a proposed redefinition of life. Experimental work was mainly in the fields of mammalian thermoregulation and on the chemistry of blood constituents which appear to be homokinatically regulated by hormonal and electrical mechanisms. Included is a discussion on the use of concepts in the spectral analyzer approach to the analysis of living systems. S.C.W.

N68-37859*# Naval School of Aviation Medicine, Pensacola, Fla.
LABYRINTHINE DEFECTS AS SHOWN BY ATAXIA AND CALORIC TESTS
Alfred R. Fregly and Ashton Graybiel Aug. 1968 19 p 8 refs (NASA Order R-93)
(NASA-CR-97365; NAMI-994) CFSTI: $3.00/MF $0.65 CSCL 06P

Groups of individuals with various loss or disturbance of labyrinthine function (N=49) and patients who had vertigo as a major symptom or complaint (N=76) were very different from a control group of normals (N=240) in the frequency with which their ataxia test battery performance scores and threshold caloric test responses fell within the lowest 5 per cent of the normative distributions. Generally, caloric test results could be predicted from ataxia test results better than results of ataxia tests from those of caloric tests in the various groups. In those individuals with total or near total loss of labyrinthine function all test findings were in perfect or near perfect agreement in relation to the 5th percentile cut-off criterion employed. Author

N68-37871*# Sandia Corp., Albuquerque, N. Mex.
AN IMPROVED TECHNIQUE FOR MICROBIOLOGICAL SAMPLING OF SURFACES: AGAR SPRAY Research Report, Period Ending 30 Sep. 1968
F. W. Oswald, L. W. Hughes (N. Mex. Univ.), M. E. Morris, and J. W. Beakley (N. Mex. Univ.) Sep. 1968 18 p
(NASA Order R-09-019-040; Proj. 0064010)
(NASA-CR-97349; SC-RR-68-593) CFSTI: HC $3.00/MF $0.65 CSCL 06M

This report describes an improved technique for biological sampling of surfaces. While previous approaches have been limited to the removal of the microorganisms from the surfaces, the technique described herein deletes this often questionable operation and initiates growth and enumeration of the organisms *in situ*, i.e., without removing them from the surface. The method employs spraying molten (53°C) agar media directly onto the surface to be sampled and incubating the microorganisms thereon. A description of the spray apparatus with drawings is provided. Test results and advantages of the technique are presented. Author

N68-37876*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.
THE BIOCHEMICAL, PHYSIOLOGICAL AND METABOLIC EVALUATION OF HUMAN SUBJECTS DURING A SIMULATED GT-7 MISSION Final Technical Report, 19 Sep.–1 Nov. 1965
Bernard J. Katchman, James P. F. Murphy, Carol A. Linder and Vickie R. Must Wright-Patterson AFB, Ohio AMRL Dec. 1967 60 p 43 refs
(NASA Order R-85; Contract AF 33(657)-11716)
(NASA-CR-97363; AMRL-TR-67-165) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Four human male subjects were confined for six weeks during which time they participated in a simulated Gemini 14-day flight. They ate a diet of bite sized compressed foods for 30 consecutive days; 14 days were spent in a Life Support Systems Evaluator. This diet was organoleptically unacceptable. It was significantly less digestible than the fresh food diet and caused an increase in fecal void frequency and a significant increase in fecal mass. The protein in the diet was sufficient to maintain the subjects in positive balance for nitrogen but the mineral content (except magnesium) was inadequate. The subjects were in negative balance for sodium, potassium, phosphorus, calcium, and chloride but in positive balance for magnesium. Under the conditions of these tests, 1500 m/l/man/day of water were adequate. Water balance data and urinary 17-hydroxycorticoids attest to the low level of activity in the chamber. Blood pressure, oral temperature, pulse rate, respirations, hematology, and blood chemistries were all in the normal range of clinical values. Author

N68-37988# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Bad Godesberg (West Germany).
INVESTIGATIONS ABOUT THE REACTION OF BLOOD FLOW IN HUMAN SKIN UNDER EXPOSURE TO HIGH AND LOW PRESSURE [UNTERSUCHUNGEN UEBER DAS VERHALTEN DER MENSCHLICHEN HAUTDURCHBLUTUNG-SGROESSBE BEI UEBER- UND UNTERDRUCKEXPOSITION]
K. Held Sep. 1968 79 p Refs In GERMAN; ENGLISH summary
(DLR-FB-68-56; DVL-784) CFSTI: HC $3.00/MF $0.65

This report is aimed at settling the question concerning the reaction of human skin blood flow. For this reason, measurements of cutaneous circulation with thermal-conductance-heads have been performed with male subjects under 1 to 4 atmospheres and in simulated high altitudes of 9.800 to 18.750 ft. The results showed unchanged levels during exposure to high pressure and a significant increase of blood flow in subatmospheric pressure. In a subsequent discussion we try to analyze the causal factors for these reactions. Author

N68-38008# Joint Publications Research Services, Washington, D. C.
SOVIET REPORTS DELIVERED AT UNITED NATIONS SPACE CONFERENCE
9 Oct. 1968 48 p refs Transl. into ENGLISH from Russian Conf. Speeches Presented at the 34th United Nations Conf. on Space Res. and Use for Peaceful Purposes, New York, Jun. 1968
(JPRS-46630) CFSTI: HC $3.00/MF $0.65

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3. HUMAN PHYSIOLOGY IN RELATION TO CONQUERING SPACE V. V. Parin p 23–37 refs (See N68-38011 24-04)

N68-38009# Joint Publications Research Services, Washington, D. C.
SPACE RESEARCH AND THE BIOLOGICAL SCIENCES
O. G. Gazenko *In its* Soviet Rept. Delivered at United Nations Space Conf. 9 Oct. 1968 p 1–12 refs (See N68-38008 24-04)

The role that space biology will play in providing information on terrestrial needs is discussed in the context of its interrelationships with space engineering, spacecraft experiments, cosmonautics, and the numerous medical problems related to manned space flights. The important corollaries resulting from the development of cosmonautics are identified as (1) studies of the evolution of living matter in the universe, and experimental investigations of life forms on other planets; (2) creating highly efficient and multicomponent biological systems for space cabins or planetary stations; (3) the

ecological approach to evaluating the biological acceptability of an artificial human environment; (4) the applications in clinical practice of data obtained on the physical effects of weightlessness; and (5) the broad implementation of biotelemetric systems. M.G.J.

N68-38011# Joint Publications Research Services, Washington, D. C.
HUMAN PHYSIOLOGY IN RELATION TO CONQUERING SPACE
V. V. Parin *In its* Sov. Rept. Delivered at United Nations Space Conf., 9 Oct. 1968 p 23-37 refs (See N68-38008 24-04)

Theoretical principles of space physiology are defined, and the general methodological concepts are characterized. The application of biocybernetics to clinical medicine is examined, and several examples are cited to show the impact of such space-developed techniques. The data show: (1) A diagnostic algorithm can be developed for evaluating the state of the central regulation of blood circulation apparatus solely on the basis of pulse rate. (2) Seismocardiographic investigations established the relationship between intracardiac and extracardiac compensation factors for healthy individuals under space flight conditions and for various cardiac patients. (3) A philosophy of medicine is developing which regards the living organism in its dielectric relationship to the environment as a dynamic system whose reactions, although not determined, are subject to prediction. M.G.J.

N68-38014# Instituto di Richerche Farmacologiche (Mario Negri), Milan (Italy).
PHARMACOLOGICAL AND BIOCHEMICAL CHANGES IN ANIMALS MADE AGGRESSIVE BY ISOLATION Final Technical Report
S. Consolo, S. Garattini, E. Giacalone, and L. Valzelli May 1968 37 p refs
(Contract DAJA-37-67-C-0586)
(AD-674665) CFSTI: HC $3.00/MF $0.65

The decrease of brain serotonin turnover in aggressive animals was confirmed and was found to be proportional to the different conditions of graded isolation experimentally adopted. Other biochemical parameters, as represented by brain noradrenaline turnover and N-acetyl-L-aspartic acid levels, are changed by prolonged isolation. More precisely in aggressive mice brain noradrenaline turnover is increased whereas the levels of N-acetyl-L-aspartic acid are decreased: no evident changes can be found for what is concerning the cholineacetylase activity in brain between normal and aggressive mice. Chlordiazepoxide showed the interesting property of preventing the behavioral effect of isolation, when administered chronically to the animals. Author (TAB)

N68-38051*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES
Sep. 1968 168 p refs
(NASA-SP-7011(54)) CSCL 06S

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during the following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N68-38077# Indiana Univ., Bloomington. Dept. of Psychology.
CONDITIONS CONTRIBUTING TO VARIABILITY IN PULSE VOLUME
Yvette Gagnon Aug. 1968 13 p
(Contract Nonr-908(15))
(TR-28; AD-674448)

The purpose of this report is to suggest some conditions which contribute to the variability of pulse volume (and conceivably other autonomic measures as well). Specifically, the influence of recording site (preferred vs. non-preferred hand), arousal conditions (aroused vs. relaxed), and a personality dimension (introversion vs. extraversion) is discussed. The effects of these variables are illustrated by graphs. Author (TAB)

N68-38099# Armed Forces Radiobiology Research Inst., Bethesda, Md.
EFFECT OF PREIRRADIATION AND POST IRRADIATION ERYTHROPOIETIC STIMULATION ON SURVIVAL FOLLOWING EXPOSURE TO HEMATOPOIETICALLY LETHAL X-RAY DOSES Scientific Report
J. P. Okunewick and K. M. Hartley May 1968 24 p refs
(AFRRI-SR68-13; AD-674860) CFSTI: CH HC $3.00/MF $0.65

Experiments were carried out to evaluate the effect of erythropoietic stimulation on postirradiation survival. A/He and Swiss mice were stimulated to produce red cells at a greater than normal rate through the use of a high altitude chamber. The response to stimulation both before irradiation and after irradiation was examined and compared with that shown by simultaneously irradiated but unstimulated control animals. The mice were maintained at a normal atmosphere for about 3 hours after irradiation in the case of the postirradiation stimulation and for 3 days prior to irradiation in the case of the preirradiation stimulation. The effect of postirradiation stimulation was tested at 700 and 775 R. The poststimulated mice demonstrated poorer survival than the unstimulated controls. These doses were 100 percent lethal at 30 days to both groups, however the mean survival time of the irradiated, stimulated mice was shorter than that of irradiated, unstimulated controls, 4.9 days versus 5.9 days respectively at 775 R, and 5.9 days versus 7.4 days at 700 R. In contrast, mice which were previously erythropoietically stimulated by 3 weeks continuous exposure to one-half atmosphere exhibited a markedly better postirradiation survival than did the unstimulated controls. The effect of preirradiation stimulation was tested at 675 R, 725 R and 775 R. Increased 30-day survival of the prestimulated animals over that of the untreated controls was found at all doses. Author (TAB)

N68-38164*# Techtran Corp., Glen Burnie, Md.
THE BEHAVIOR OF LIVE FROG EGGS AND FROG LARVAE IN DISTILLED WATER [UBER DAS VERHALTEN LEBENDER FROSCHEIER UND FROSCHLARVEN IN DESTILLIERTEM WASSER]
Jaroslav Kriezencki Washington NASA Oct. 1968 17 p refs Transl. into ENGLISH from Arch. Entwicklungsmech. Organ. (Berlin), v. 42, 1917 p 604-621
(Contract NASw-1695)
(NASA-TT-F-11962) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The factors in survival and development of frog eggs and larvae in distilled water are analyzed, oxygen in the water and nutrition being found to be decisive factors. Experiments with frog eggs and larvae in distilled and common water are reported. Author

N68-38178# Sandia Corp., Albuquerque, N. Mex.
LASER EYE AND SKIN HAZARD EVALUATIONS
W. D. Burnett Mar. 1968 29 p refs
(Contract AT(29-1)-789)
(SC-DC-68-2108; CONF-680503-1) CFSTI: HC $3.00/MF $0.65

A method is presented for the systematic evaluation of laser direct-beam hazards to the eyes and skin. The three parameters required for calculation of the exposure intensity incident on the

surface of the eye or skin were laser output, laser beam divergence, and the range. Knowledge of the exposure intensity was not considered to be sufficient for evaluation of laser hazards to the eye since optical transmission characteristics of the eye account for retinal exposure. The hazards from exposure of the eye to uv and infrared wavelengths are also discussed. NSA

N68-38207*# Spacelabs, Inc., Van Nuys, Calif.
APOLLO MEDICAL EXPERIMENTS SYSTEM Final Report
8 Oct. 1968 133 p
(Contract NAS9-5431)
(NASA-CR-92348; SR68-1055) CFSTI: HC$3.00 CSCL 06S

The Medical Experiments Program involves the measurement of various physiological phenomena under conditions imposed by the Apollo flight environment. Design, development, and technical aspects of the Medical Experiments System are described in this report. The system consists of: (1) the phonocardiogram subsystem (PCG) for detecting Korotkow sounds; (2) the electroencephalogram subsystem (EEG) for measuring brain wave activity; (3) the vectorcardiograph subsystem (VCG) for vector representation of the standard electrocardiogram signals; and (4) the thoracic blood flow measurement subsystem (ZCG) for determining thoraic impedance variations. A program chronology, subsystems documentation, and schematic drawings are included. K.W.

N68-38290# Office of Naval Intelligence, Washington, D. C.
AIRBORNE SURVEYING OF THE GLOBAL FRAGMENT CONTAMINATION OF TERRITORIES IN THE GAMMA-RAY SPECTRUM [IZMERENIYE S SAMOLETA GLOBAL'NOGO OSKOLOCHNOGO ZAGRYAZNENIYA TERRITORY PO SPEKTRU GAMMA-LUCHEY]
L. I. Boltneva, A. V. Dmitriyev, R. M. Kogan, V. A. Ionov et al
3 Jul. 1968 12 p refs Transl. into ENGLISH from Fiz. Zemli (USSR) no. 2, 1967 p 114–120
(ONI-TRANS-2634; AD-674489) CFSTI: HC$3.00/MF$0.65

The atmosphere, the terrain and the natural water become radioactively contaminated after lengthy, atmospheric, nuclear testing. Radioactive products get into vegetation and living organisms and have a harmful biological effect on them. There is also danger from the external irradiation of organisms, which is occasioned by radioactive contamination of the natural environment. Information on the natural environments contamination is necessary for solving diverse problems of agriculture, medicine and biology. Author (TAB)

N68-38354# Illinois Univ., Urbana. Biophysical Research Lab.
UHF ACOUSTIC ATTENUATION AND RESEARCH IN BIOLOGICAL ACOUSTICS Final Report
Floyd Dunn 21 Aug. 1968 20 p refs
(Contract Nonr-1834(29))
(AD-674519) CFSTI: HC$3.00/MF$0.65

The report summarizes research on the following topics: instrumentation for the generation and detection of UHF sound in liquids, ultrasonic absorption spectroscopy in solutions of biological macromolecules, degradation of DNA by intense noncavitating ultrasound, effects of intense noncavitating ultrasound on proteins in solutions, noncavitating ultrasonic effects in biological media, acoustically induced birefringence in liquids, and correlation of naturally occurring infrasonics and selected human behavior. Author (TAB)

N68-38367# California Univ., Livermore. Lawrence Radiation Lab.
SOLUTION OF THE TIME-DEPENDENT EQUATIONS FOR TAUTOMERIC INTERCONVERSION IN THE A-T AND G-C BASE PAIRS OF DNA
Balazs Rozsnyai 10 Apr. 1968 28 p refs
(Contract W-7405-ENG-48)
(UCRL-50412) CFSTI: HC$3.00/MF$0.65

Solutions of a set of four first-order coupled differential equations governing the tautomeric interconversion rate of the DNA base pairs are presented. The method of calculation represents a simplified way of treating the quantum mechanical tunnel effect for the protons forming the hydrogen bonds between the nucleotide base pairs of DNA. Results are presented for the A–T and G–C base pairs for several cases of interest. Author (NSA)

N68-38486# Hofstra Coll., Hempstead, N. Y.
THE EFFECT OF HIGH INTENSITY INTERMITTENT STIMULI ON HUMAN BEHAVIOR AND PHYSIOLOGY Final Report, 1956–1967
Robert Plutchik Apr. 1968 26 p refs
(Contract Nonr-2252(01))
(AD-673970)

Intermittent tones are judged as unpleasant or painful at lower intensity levels than steady tones and pain thresholds are related primarily to power per pulse rather than total energy in a series of pulses. Skin impedance characteristics varied widely with electrode location and females had significantly higher skin impedance than males. The impedance of the human skin decreased from 130 to 30 kohm as the frequency of the a-c input increased from 1 to 1000 cps. Phase angle also decreased over this frequency range. High intensity intermittent sound had no effect on mean heart, rate, blood pressure of skin temperature, but did produce a decrease in skin impedance which was linearly related to the intensity of stimulation. Using an EEG frequency analyzer, it was found in all subjects that 10 cps pulse rate inputs at auditory pain threshold produced a partial inhibition of the alpha rhythm. Maximum evoked responses to auditory clicks were obtained with monopolar leads over the motor area and the parietal area and evoked responses to flashes of light were quite different from those to auditory pulses. Stimulus intensity and repetition rate affected some characteristics of the evoked response and the simultaneous presentation of clicks and flashes of light changed the pattern of the response. Comparing photic stimulation, audio stimulation, hyperventilation, electric shock and condition, results showed that photic stimulation produced the maximum decrease in percent time alpha, but the effect was mainly an on-off one. Heart rate decreases occurred during photic stimulation and during the weak auditory CS, findings which seem consistent with Laceys concept of environmental intake. Author (TAB)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-37461 Washington Univ., Seattle.
A STUDY OF PREFERRED LISTENING LEVELS AND THEIR RELATIONSHIP TO LEVELS OF MAXIMUM SPEECH DISCRIMINATION ABILITY
Stanford Harold Lamb (Ph.D. Thesis) 1967 82 p p 82
Available from Univ. Microfilms: HC$4.40/Microfilm $3.00 Order No. 68-3860

Instructions were devised that asked the listener to select the level at which he could understand best everything being said for a sample of connected discourse. The connected discourse material was taped and fed into a commercially available self-testing automatic audiometer which allowed the rate of intensity change

and the duration of the listening task to be carefully controlled. The purpose of this study was to describe and evaluate this method with respect to its reliability and validity on both normal hearing and hearing impaired listeners. Ten normal-hearing and 20 sensori-neural hearing loss individuals were tested twice. The Most Intelligible Listening Levels (MILL) administered with an automatic audiometer was highly reliable over short and longer time intervals for both normal and hearing impaired listeners. A very low correlation was found between the MILL and the level of maximum speech discrimination ability for hearing impaired listeners. A high percentage of the hearing impaired listeners experienced a significant decline in their speech discrimination ability at hearing levels above their PB maximum level. This suggests the need for audiologists to measure speech discrimination ability at more than one sensation level. Dissert. Abstr.

N68-37462 Ohio State Univ., Columbus.
SPEECH AUDIOMETRY BASED ON THE SELECTED BAND-PASS FILTERING OF WORDS
Sidney Jordan (Ph.D. Thesis) 1967 p 131
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-3004

Responses of listeners to words selected on the basis of their octave band-pass patterns were investigated. Twenty-four normal listeners judged sixty-six disyllabic words by indicating which one of four filtered versions of a word was most like the unfiltered version with respect to the distinctiveness of the phonemes. The pass bands for the four filtered versions were 660 Hz to 1320 Hz, 1320 Hz to 2640 Hz, 2640 Hz to 5280 Hz, and 4080 Hz to 8160 Hz. In a similar manner, a second group of 24 normal listeners judged 114 monosyllabic words and nonsense syllables. Words or nonsense syllables were considered to be low-frequency words or nonsense syllables if the 660 Hz to 1320 Hz band was significantly selected as being most like the unfiltered version of the word or nonsense syllable, medium-frequency if the 1320 Hz to 2640 Hz band was significantly selected, and high-frequency if the total selections for the 2640 Hz to 5280 Hz and 4080 Hz to 8160 Hz bands were significant. The component syllables of disyllabic words do not tend to fall significantly into the same frequency categories as the entire disyllabic word. Monosyllabic words are more suitable as material for speech audiometry based on the frequency of words than are disyllabic words. Dissert. Abstr.

N68-37641 Indiana Univ., Bloomington.
THE INFLUENCE OF UNISENSORY AND BISENSORY PRACTICE UPON AUDITORY DISCRIMINATION
Davis Anthony Scott (Ph.D. Thesis) 1967 74 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-2359

This study investigated the influence of four kinds of practice condition upon auditory discrimination skills. Subjects included 40 college students with normal hearing. During auditory discrimination tests and whatever auditory training sessions they participated in, subjects were exposed to speech signals distorted by means of a filter with low-pass frequency cut-off at 900 Hz. Ten subjects were assigned to each of four practice conditions. One practice condition involved no training. The other three conditions required participation in a series of ten auditory training sessions. One of these three conditions provided bisensory stimuli during training (both visual and distorted auditory cues); another provided bisensory and unisensory stimuli alternately from session to session; the third provided unisensory stimuli (one distorted auditory cues). Prior to and following training, subjects took auditory discrimination tests. The results demonstrated that residual hearing could be made more functional through auditory training and that more improvement could be expected with unisensory training procedures. Dissert. Abstr.

N68-37735*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
COMPARISON OF HUMAN RESPONSE MODELING IN THE TIME AND FREQUENCY DOMAINS
Lawrence W. Taylor, Jr. 1967 35 p 8 refs Presented at the USC/NASA Conf. on Manual Control, Los Angeles, 1–3 Mar. 1967 Previously announced as N68-25276
(NASA-TM-X-59750) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Frequency and time domain methods of analyzing human control response while performing compensatory tracking tasks are reviewed. Sample linear model results using these methods are compared and discussed. The inherent requirement of constraining the freedom of the form of the pilot models is also discussed. The constraint in the frequency domain consists of smoothing with respect to frequency; whereas, the constraint for the time domain model is more natural and meaningful in that it consists simply of limiting the memory of the pilot model. The linear models determined by both methods were almost identical. The time domain method of analysis enables the determination of a nonlinear pilot model. The inclusion of a cubic as well as a linear term accounted for only a small additional part of the pilot's remnant and indicated that only a small portion of the total power of the pilot's output is caused by nonlinearities. The power spectral density of an ensemble average of the pilot's output is used to determine the upper limit of the amount of power associated with a deterministic response. The indication is that more than half the remnant is stochastic when a linear model is used. Author

N68-37747# Isomet Corp., Palisades Park, N. J.
A SOLID ELECTROLYTE CARBON DIOXIDE REDUCTION SYSTEM Final Report, Nov. 1965–Aug. 1967
Horace W. Chandler and Lawrence J. Howell Wright-Patterson AFB, Ohio AMRL Jan. 1968 92 p 7 refs
(Contract AF 33(615)-3320)
(AMRL-TR-67-209; AD-672006)

Solid electrolyte cells utilizing a 90 mole percent ZrO_2(-10) mole percent Y_2O_3 electrolyte and platinum electrodes were used for the reduction of carbon dioxide to carbon monoxide and oxygen. Methods of fabricating multicell units were investigated and the performance of these units under a variety of temperature conditions and feed gas compositions was studied. Current efficiencies of these units were found to vary with temperature and current density when pure carbon dioxide was used as a feed. Multicell units were operated continuously for up to 750 hours with no evidence of cell deterioration. Studies on single-cell units were carried out to correlate cell polarization effects with feed gas composition, voltage and current density at a fixed temperature. Author (TAB)

N68-37770# Texas Univ., Austin. Electronics Research Center.
A STUDY OF PROPOSED NEURAL EXCITATION BY INTERACTION OF ULTRASONIC AND ELECTROMAGNETIC ENERGY
James D. Wolfe and Elmer L. Hixson 1 May 1968 124 p refs
(Grant AF-AFOSR-766-67)
(AFOSR-68-0879; TR-48; AD-672002)

A neural stimulation system is proposed exploiting the low frequency response of neurons to an excitation potential. Ultrasonic and electromagnetic energy interact in electrolytic solutions due to conductivity variations caused by the ultrasonic pressure waves in the solution. The potential of largest magnitude resulting from the interaction has a frequency equaling the sum and difference of the ultrasonic and electric field frequencies. The frequency of the applied field is chosen to exceed the response time of the neurons, preventing excitation; the frequency of the induced potential, being the difference of two frequencies, can be constrained to fall within the response time of neurons and produces excitation. The shape

and position of the volume containing the excitation potential is controlled by focusing the ultrasonic waves to high intensity in a small volume. The system is modeled both electrically and ultrasonically by a simple salt solution similar to body interstital fluids. The relevant field equations for a conducting solution are applied to the model; the conductivity function contains a small time varying perturbation which is a linear function of the local dynamic pressure due to a focused ultrasonic source. The resultant nonlinear, partial differential equation is solved by an assumed power expansion of the solution in applying perturbation theory. Author (TAB)

N68-37819*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DISCRIMINATION OF INCREASES IN THE BRIGHTNESS OF A FLASHING BEACON
R. S. Lincoln, S. Seidenstein and C. V. Juliano Washington NASA Oct. 1968 47 p 8 refs
(Contract NAS1-6801)
(NASA-CR-1220) CFSTI: HC$3.00/MF$0.65 CSCL 05E

The effects, on pilot judgments, of four variables were studied: beacon flash rate, beacon on time, beacon intensity, and rate of vehicle closure. The 25 subjects viewed a point source beacon, represented by a xenon arc lamp, through a lens that provided a virtual image of the beacon at a point near infinity. Flash rate and on time were controlled by motor driven cams, while closure rate was controlled with a servomotor that rotated a circular neutral filter, the density of which increased linearly. Initial brightness was varied with a second circular filter. In a counter-balanced experimental design each subject was exposed to combinations of all four variables, each at five levels. On certain trials, a steady rather than a flashing beacon was employed. The principal measure of performance was the time required to discriminate a change in beacon brightness, measured from the initiation of a trial to its termination by the subject when he was absolutely sure that the brightness of the beacon had increased. The results indicated that the thresholds for brightness increase were positively related to the rate at which the brightness of the beacon increased. Author

N68-37897# Melpar, Inc., Falls Church, Va.
RESEARCH ON SUBMICRON METAL-FIBER SOLUTIONS Final Report, 1 Mar.–30 Nov. 1967
S. C. Ban, F. D. Ordway and F. E. Swindells 30 Nov. 1967 58 p refs
(Contract AF 33(615)-5431)
(Rept.-6339-F; AD-672004)

The program is a study of possible mechanisms for use in a fast-acting, variable-density filter for high intensity flash protection. Fibers of boehmits, silicon carbide, and snapphire, with and without metal coatings, were dispersed in amyl acetate-toluene mixture, observed in an electro-optical test cell. Absorption spectra and light scattering measurements did not show a strong, specific absorption at a wavelength twice the fiber length. Discussion of theoretical results suggests such absorption is not to be expected. Experiments with electrochromic cells revealed that high-voltage activation is effective mostly through gas generation rather than oxidation of leuco dye. The two processes are almost equally efficient. To develop a workable flash-protection device, the use of a combined gas-bubble/electrochromic cell appears most promising. Author (TAB)

N68-38010# Joint Publications Research Services, Washington, D. C.
PROFESSIONAL WORK OF THE COSMONAUT
Yu. A. Gagarin *In its* Soviet Rept. Delivered at United Nations Space Conf. 9 Oct. 1968 p 13–22 refs (See N68-38008 24-04)

The importance of man in space exploration is stressed, and the principal factors involved in the selection and training of cosmonauts are discussed. The main requirements are listed as perfect health, profound knowledge in various field of science and technology, skill in conducting research work, pilot experience, and certain necessary psychophysiological qualities. Space flight training is discussed in relation to flight and parachute training; engineering and technical training; flight simulation and survival training; and biomedical training to increase the functional capacities of the body, improve tolerances to space flight stress, and increase work capacity. An overview is presented on cosmonaut performance during the Vostok, Voskhod, and Soyuz flights. M.G.J.

N68-38061# Dynatech Corp., Cambridge, Mass.
A DIELECTROPHORETIC LIQUID OXYGEN CONVERTER FOR OPERATION IN WEIGHTLESS ENVIRONMENTS Final Report, 17 Jan. 1966–22 Dec. 1967
John R. Blutt and Mathew Hurwitz Jul. 1968 199 p refs
(Contract AF 33(615)-3583)
(AMRL-TR-68-21; AD-674616) CFSTI: HC$3.00/MF$0.65

Analyses, experiments, and designs were executed to establish the performance characteristics, optimum weight, and safety of a dielectrophoretic liquid oxygen converter. A theory was developed for electric field gradient stabilization of liquid/vapor systems. Laboratory liquid-liquid experiments and KC-135 zero-g tests corroborated the theoretical performance. Vibration tests demonstrated the structural integrity of typical electrodes and their supports. Also experiments were conducted to determine the electrical breakdown strength of cryogenic oxygen. These tests demonstrate the compatibility and safety of typical electrode and support structures under intense electric fields and even under electrical arcs having orders of magnitude more energy than could be experienced in practice. A computer and analysis was used to determine minimum weight system designs based on experimentally verified performance equations, structure weight formulas, and safety criteria. The total weight of the dielectrophoretic electrodes, supports, power supply, and tank feedthrough to orient the liquid in a 25-liter oxygen converter subject to randomly directed accelerations up to 0.001 g is 7 lbs. The operating voltage is 21 kv. A preliminary design is presented for a 25-liter converter system for orbital flight testing. Author (TAB)

N68-38073# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
AUDITORY FATIGUE FOLLOWING TONE-BURST TRAINS AT 2.2 KC
J. Donald Harris 28 May 1968 13 p refs
(SMRL-529; AD-674500)

Three hundred and two sailors were exposed by phones in groups of 11-20 men to 2.2 kilocycle/sec (kc) pulses (5 msec rise-fall time) of 37-250 msec pulse duration at 105-120 dB sound pressure level, duty cycle (on-time/total time) from 0.1 - 100%, and for 5-120 min/session. Permutations were selected to throw direct light on the four stimulus variables and on their interactions as well. Pulse-tone audiometry by magnetic tape was accomplished 7 times in 6 min at 2.5, 3, 4, 6, and 8 kc, before and immediately after exposure. The concept of a criterion temporary threshold shift (TTS) was developed in which 1 Kryt represents the area of TTS plotted on an audiometric chart from 2-8 kc. Any TTS can then be expressed in terms of the Kryt. Thus, for each of our subjects, for each of seven audiograms taken approximately once per minute, we have seven successive Kryt values. When plotted over recovery time, these values can be compared to the area enclosed on the graph representing 1 Kryt lasting for 2 min; this summation datum is termed the Nox. Mean Nox values for each experimental condition were determined. Within our data (1) each 5 dB SPL adds 0.5 Nox; (2) pulse duration as such is negligible; (3) each log session duration adds 0.65 Nox; and (4) the Nox is a linear function of duty cycle. Subjective and to some extent objective observations lead us to set a damage risk criterion of 2 Nox for pulsed stimulation at 2.2 kc. Graphs are provided by which

any combination of stimulus parameters which would yield 2(+) Nox may be predicted. Author (TAB)

N68-38172# George Washington Univ., Alexandria, Va. Human Resources Research Office.
FROM RESEARCH TO PRACTICE IN ELECTRONICS MAINTENANCE TRAINING
William A. McClelland Jun. 1968 13 p ref Presented at the Army Command School Curriculum, Fort Knox, Ky., Feb. 1967
(Contract DA-44-188-ARO-2)
(PP-21-68; AD-674738) CFSTI: HC $3.00/MF $0.65

The problem of converting research results into training practice in the area of U.S. Army electronics maintenance is discussed. The need for a systematic, generalized procedure for designing, testing, and revalidating training courses is emphasized. Functional context training and a course using new instructional techniques are described. Author (TAB)

N68-38197# Army Aeromedical Research Unit., Fort Rucker, Ala.
USER EVALUATIONS OF TWO AIRCREW PROTECTIVE HELMETS
James A. Bynum Aug. 1968 37 p refs
(USAARU-69-1; AD-674184) CFSTI: HC $3.00/MF $0.65

Two aircrew protective helmets were evaluated by 24 instructor pilots who were divided equally into groups subjected to three ambient noise environments. Pilots rated the Army APH-5 and the SPH-3X (Experimental) on eight categories designed to assess relative comfort, acceptability, and noise attenuation. Ratings were compared, using a Split-Plot Factorial Analysis of Variance. Author (TAB)

N68-38337# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME ASPECTS OF PATTERN RECOGNITION WITH THE APPLICATION OF THRESHOLD ELEMENTS [NEKOTORYE METODY RASPOZNAVANIYA OBRAZOV S PRIMENENIEM]
A. B. Shubin 29 Nov. 1967 12 p refs Transl. into ENGLISH from the book "Samoobuchayushchiesya Avtomaticheskie Sistemy" Moscow, Acad. of Sci., 1966 p 94-101
(FTD-HT-23-1044-67; AD-673929)

The general problem of pattern recognition is briefly discussed from a purely theoretical point of view, with attention given to the various interrelated aspects and suppositions involved. It is shown that, technically speaking, the realization of the pattern recognition problem breaks down into two sub-problems which are to some degree independent: (1) the rational selection, or organization of the selection, of the essential (to recognition) coordinates of the pattern; (2) the actual recognition of the pattern according to the coordinates selected. Pattern coordinate selection is discussed on the basis of a generalized block diagram of a recognition device using threshold elements for the segregation and recognition of local attributes in a stage between the picture coordinates and the recognition circuit. The method of scanning the adjustment of the threshold element and the attribute discrimination process (primarily through external configuration coordinates) are discussed in detail. TAB

N68-38374# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
STIMULUS RATE DIFFERENCES AND VIGILANCE PERFORMANCE
S. Klier and R. Pain Oct. 1968 11 p refs
(RM-427)

An investigation was conducted of the effectiveness with which monitoring behavior occurs in long term vigils. Identification of the factors affecting this behavior is important in the design of equipment and training procedures aimed at improving a signal detection. During an 80-minute vigil, subjects responded to a difference in the brightness between two successively illuminated lights. In one condition (fast stimulus rate) 2400 pairs of lights were presented, 20 of which were different in brightness. In another condition, 400 pairs were presented, (slow stimulus rate) 20 of which were different. The percentage of signals correctly detected was significantly higher for the slow stimulus rate, although the number of signals presented and the total length or time were the same for both conditions. These results substantiate those in the literature and have implications for explaining monitoring behavior in vigilance situations. Author

N68-38435# Conductron-Missouri, St. Charles.
SYNTHETIC FLIGHT TRAINING SYSTEM DEVICE 2B24 Concept Formulation Report
J. T. Clausen, J. G. Curtin, J. F. Egler et al Orlando, Fla. Naval Training Device Center Jul. 1968 343 p refs
(Contract N61339-68-C-0108)
(NAVTRADEVCEN-68-C-0108-1; AD-673982) CFSTI: HC $3.00/MF $0.65

The concept formulation was developed to determine the technical feasibility, economic and military training considerations related to the development of the Synthetic Flight Training System (SFTS). Trainer performance, operating characteristics and training technology were analyzed to determine SFTS requirements and implementation techniques. Configurations were synthesized and compared in trade-off analysis and the best technical approach was selected to provide common modules for the trainer. Author (TAB)

N68-38436# RAND Corp., Santa Monica, Calif.
INFORMATION AND INDUCTION: A SUBJECTIVISTIC VIEW OF SOME RECENT RESULTS
Dan Jamison Aug. 1968 49 p refs Submitted for publication
(P-3921; AD-674038) CFSTI: HC $3.00/MF $0.65

Four purposes are attributed to the paper: (1) to attempt to provide a definition of semantic information that is adequate from a subjectivist point of view and that is based on the concept of information as change in belief; (2) to suggest a solution to the inductive problem that Suppes points out to lie at the foundations of a subjectivistic theory of decision; (3) to show how Carnaps continuum of inductive methods may be easily interpreted as a special case of the subjectivistic theory of induction to be presented; and (4) to provide a subjectivistic interpretation of Hintikkas two dimensional inductive continuum, and show how this is related to the problem of concept formation. Author (TAB)

N68-38440# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
THE RESPONSE ANALYSIS TESTER (RATER) AND LOGICAL INFERENCE TESTER (LOGIT). II. ADDITIONAL PILOT STUDY DATA Interim Report
James W. Parker May 1968 11 p ref
(SMRL-525; NAVMED-MF022.01.04-9009-1; AD-673996)

This report presents additional, normative data for the Response Analysis Tester (RATER), a performance testing instrument, using geometric forms as stimuli. The results showed that somewhat higher scores were obtained with the geometric form stimuli than had been previously obtained using color stimuli. Examination of RATER scores as related to the Navy Basic Test Battery showed the only significant relationship to be between RATER scores and the CLER portion for men in non-technical rates only. A second part reports the results obtained using the Logical Inference Tester

(LOGIT) in a study to determine the effects of flashing light stress on performance. It was found that for two, pre-trained subjects no significant decrements in performance (number of errors) resulted from the addition of the flashing light while performing the test. The additional experience with these two performance measuring instruments has resulted in increased confidence in their usefulness. The data presented add to the cumulative data being collected and will augment base-line data available against which decrement-inducing studies can be compared. Author (TAB)

N68-38453# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ATTENTION—WEIGHTLESSNESS [VNIMANIE—NEVESOMOST]
A. V. Yegorov and G. I. Pavlov 16 Jun. 1967 89 p refs Transl. into ENGLISH from RUSSIAN
(FTD-MT-66-157; AD-674040) CFSTI: HC $3.00/MF $0.65

The article summarizes the information thus far accumulated in regard to weightlessness. The authors begin with a review of gravity, weight, and inertia, and proceed to a description of experiments already performed by astronauts with a variety of reactions. The role of the senses in orientation is reported on the basis of numerous experiments with men and animals. Since all experience up to now has involved only relatively short periods of weightlessness, the true effects on the human system of prolonged space flights is still largely unknown. It is suggested that substituting rotation for gravity will produce a suitable environment for long space journeys. Author (TAB)

N68-38457# Rome Air Development Center, Griffiss AFB, N. Y.
SPECIFICATION OF PRIMARY INTENSITIES FOR SEVEN-COLOR ADDITIVE DISPLAYS
R. J. Christman Jul. 1968 47 p refs
(RADC-TR-68-319; AD-674589)

Five subjects served in a laboratory experiment to determine the effects of luminance degradations in the three primary color channels of a seven-color film projection additive color display. Positive performance and the incidence of errors were determined for a control condition and four levels of output reduction (20, 50, 62.5, and 84%) in each of the primary channels. Effects were determined for overall performance as well as ability to read characters in each of the seven resultant colors: red, blue, green, yellow, magenta, cyan, and white. Recommendations are provided concerning tolerances for luminance reduction of the primary channels, colors to be selected for coding purposes, and application of the data to non-projection systems such as CRT phosphors and electro-luminescent displays. Author (TAB)

N68-38460# Los Alamos Scientific Lab., N. Mex.
AN INVESTIGATION OF A BUBBLER TRITIUM SAMPLER
Allen M. Valentine 26 Jul. 1968 11 p refs
(Contract W-7405-ENG-48)
(LA-3916) CFSTI: HC $3.00/MF $0.65

Investigation of a bubbler tritium sampler indicated collection characteristics similar to reported human body uptake rates for tritium gas and tritiated water vapor. The bubble collector consisted of a dry gas wash bottle with a fritted glass tip on the inlet and distilled water as the collecting medium. Tests were made under both laboratory and field conditions, and the effects of varying the flow rate, water volume, and water temperature were determined. A flow through ionization chamber instrument was used to measure the tritium concentrations sampled, and the collected tritium was determined by liquid scintillation counting. The observed collection efficiency for tritiated water vapor was >90% for sampling rates from 8 to 10 lpm, water temperatures from 25 to 35°C, and water volumes from 30 to 50 cc. Tritium gas was collected with an efficiency of <0.01% with the same sampling rates and water volumes but with a water temperature of 18°C. Author (NSA)

N68-38466# Oak Ridge National Lab., Tenn.
MEASUREMENT OF CLINICAL RADIOACTIVITY
D. A. Ross and C. C. Harris Feb. 1968 51 p refs
(Contract W-7405-ENG-26)
(ORNL-4153) CFSTI: HC $3.00/MF $0.65

A discussion is presented that is intended to help doctors and technicians understand what a pulse-height spectrometer is, what it can do, and what it should not be expected to do. It offers the operator: a means of finding out, easily, which γ energies the instrument is counting, and the privilege of adjusting the energy pass band to suit the counting problem at hand; relative freedom from errors due to uncontrolled scattered radiation; an improved signal-to-background ratio, since much of the background is out of sight; improved stability, when the instrument is operated correctly; greater freedom in using two nuclides together, since the instrument can, within limits, pick out the characteristic radiations individually; and a powerful analytical tool that can check the radiochemical purity of supplied material, or establish the identity of an unknown emitter, by revealing the γ-ray spectrum. These advantages become available only at a price. A spectrometer is more expensive than an ordinary threshold scaler, which, in effect, has a window sill but no window top; there are more components in a spectrometer to get out of order, and it requires careful and informed operation. NSA

N68-38474# George Washington Univ., Alexandria, Va. Human Resources Research Office.
COLLECTED PAPERS PREPARED UNDER WORK UNIT LIFT: ARMY AVIATION HELICOPTER PILOT TRAINING
Jun. 1968 28 p refs
(Contract DA-44-188-ARO-2)
(HUMRRO-PP-18-68; AD-673936) CFSTI: HC $3.00/MF $0.65

Results of studies to develop more efficient and more effective methods for Army helicopter pilot training are discussed in this publication. The papers include: The effects on flight proficiency measurement reliability of differences on check pilot standards, by George D. Greer, Jr.; Briefing on Task LIFT, by John O. Duffy and Oran B. Jolley; A quality control program applied to helicopter training, by John O. Duffy; and Flight training quality control, by John O. Duffy and Edgar N. Anderson. Author (TAB)

N68-38478# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAN AND TECHNOLOGY
V. P. Zinchenko et al Oct. 1967 75 p refs Transl. into ENGLISH from Chelovek i Tekhn. Sistemy Upr. i Inzh. Psikhologiya (Moscow), 1965 p 3-48
(ATD-MT-24-328-67; AD-674696) CFSTI: HC $3.00/MF $0.65

Contents: Problem of the cybernetic century; Human factors and operator activity; Perception -- Decision action; In the language of models. TAB

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-37423 California Univ., San Diego.
THE ZEEMAN AND STARK EFFECTS IN PORPHYRIN
Michael Myron Malley (Ph.D. Thesis) 1967 244 p
Available from Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 68-3247

Observations of the absorption spectra of metal-free porphyrin and metalloporphyin in the presence of a magnetic field (the Zeeman effect) and an electric field (the Stark effect) are presented. The absorption bands of several D_{4h} symmetric porphyrins including zinc and magnesium coproporphyrin tetramethyl ester and the di-protonated metal-free coproporphyrin tetramethyl ester in solution were observed with right and left circularly polarized light in a 100 kilogauss magnetic field both at room temperature and at 77°K. A simple model of the Zeeman effect in porphyrin is developed to calculate the effects of averaging arising out of the random orientation of the molecules in solution. Observations of the influence of an electric field upon the absorption spectrum of zinc and copper coproporphyrin tetramethyl ester and metal-free coproporphyrin tetramethyl ester dissolved in polystyrene are also presented. Absorbance changes induced by an alternating (500 cps) electric field of 10^6 v/cm are detected by "lock-in" techniques. All the changes in absorbance were observed to depend upon the square of the electric field, and occurred at the second harmonic of the frequency of the applied electric field. Dissert. Abstr.

N68-37427 Northwestern Univ., Evanston, Ill.
THE COMPUTATION OF STATISTICAL COMPLEXIONS AND THE VACUUM ULTRAVIOLET PHOTOLYSIS OF CYCLOBUTANONE
Robert A. Sandsmark (Ph.D. Thesis) 1967 p 132
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-3217

A Fortran program which calculates the nondegenerate statistical complexions up to ten kcal. and the remaining statistical complexions to any maximum desired energy for the harmonic oscillator molecular model is listed. It appears that this would be the most accurate and least time consuming method for determining the complexion sums and densities for the harmonic oscillator molecular model. Cyclobutanone was photolyzed at 1470 Å yielding the following major products in order of their abundance: ethylene, acetylene, propylene, allene, and 1-butene. The photolyses were performed varying the time of photolysis, the lamp intensity, the pressure of cyclobutanone, and the pressure of an inert gas. Little or no effect was seen when any of the above mentioned variables was changed. One possible mechanism was proposed. A low pressure Xenon resonance lamp which emits only at 1470 Å in the ultraviolet region is described. Dissert. Abstr.

N68-37431 Maryland Univ., College Park.
THE KINETICS OF PROTON TRANSFER REACTIONS DETERMINED BY THE SECOND WIEN EFFECT
Bert Roland Staples (Ph.D. Thesis) 1967 74 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-3387

A square wave pulse technique, the electrical field jump, was used to study the kinetics of proton transfer in acetic acid solutions. The rate constants for proton transfer in acetic acid were determined in water and in deuterium oxide at 10°, 25° and 40°C using this relaxation technique based on the second Wien effect. A minimum in both the recombination rate constant k_R and the dissociation rate constant k_D was found near 25° for acetic acid in water whereas a corresponding maximum in the rate constants occurred in dueterium oxide near 32°. These results were explained by a postulated combination of several rate controlling mechanisms each of which tends to predominate in different temperature regimes. The solvent effect on the rate constants of acetic acid was studied in methanol-water mixtures at 25°C. Dissert. Abstr.

N68-37440# Oak Ridge National Lab., Tenn.
SPECTROPHOTOMETRY OF AQUEOUS NITRIC ACID, SULFURIC ACID, AND DEUTERIUM PERCHLORIC ACID FROM 25° TO 250°C
W. C. Waggener, A. J. Weinberger and R. W. Stoughton Jul. 1968 p 19
(Contract W-7405-EN-26)
(ORNL-4279) CFSTI: HC $3.00/MF $0.65

Dilute nitric, sulfuric, and perchloric acids are applicable as solvents for spectrophotometry up to 250°C over the following ranges: 0 to 1.0 f HNO_3 from 0.6 to 1.2 μ; 0 to 0.2 f H_2SO_4 from 0.25 to 1.2 μ; and 0 to 1.0 f $DClO_4$ from 0.25 to 1.8 μ. Each of these acids reacts measurably with the titanium cell wall and the sapphire windows at rates which increase with acidity and temperature. This corrosion affects the spectral measurements as a function of time and is associated with deterioration of cell window surfaces and the presence in the sample of dissolved and suspended corrosion products. These results are part of the more general program for the development of equipment and technique for routine spectrophotometry of pure liquids and solutions over a wide range of temperature and pressure. Author (NSA)

N68-37455 Pennsylvania State Univ., University Park.
THE CARBON-OXYGEN REACTION: AN EXPERIMENTAL STUDY OF THE OXIDATION OF SUSPENDED CARBON SPHERES
Robert William Froberg (Ph.D. Thesis) 1967 p 238
Available from Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-3534

Analysis of the carbon oxygen reaction, at normal pressures, with the use of simultaneous size and weight measurements on single spheres, has substantiated the three zone theory for solid gas reactions. Experimental results have shown that the true chemical reaction is of zero order with an apparent activation energy of 45 kcal/mole. By combining a zero order, chemical reaction, rate expression with diffusion expressions, it was found that over the temperature range investigated in this study, the overall reaction rate may be described by a single rate expression. Dissert. Abstr.

N68-37507# Brookhaven National Lab., Upton, N. Y.
THE DETERMINATION OF OXYGEN IN SODIUM BY THE AMALGAMATION METHOD
T. F. Prach, L. Newman, and C. Auerbach Jun. 1968 22 p
2 refs Supported in part by AEC
(BNL-50118) CFSTI: HC $3.00/MF $0.65

The amalgamation method, when used with the proper precautions, was found to be capable of reliable and reproducible determination of oxygen to ±1 ppM, down to the 1 ppM level. Its main disadvantage, especially when radioactive samples are involved, is the large number of manipulations required. The method is being used routinely for analyzing loop samples as well as sodium from a number of special experiments. Author (NSA)

N68-37525 Kansas Univ., Lawrence.
THE TRANSITION STATE OF BASE-CATALYZED SILICON-OXYGEN BOND CLEAVAGE
Kenyon Stuart Latham, Jr. (Ph.D. Thesis) 1967 p 148
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-597

The study was undertaken to more thoroughly examine the nature of the catalytic action and the structure of the rate-limiting transition state. The investigative method chosen was a kinetic study of the methanolysis reaction in basic buffer solutions, the products being the methoxysilane and a phenol, and utilization of

structure-reactivity correlations. The methanolysis of phenoxytriphenylsilanes has been found subject to general base catalysis, proceeding via a proton-transfer mechanism. Deuterium isotope effects indicate that silicon–oxygen bonding change is the rate-limiting factor and not proton transfer. The mechanism most consistent with experimental results involves proton extraction from an attacking solvent molecule, thereby increasing its nucleophilicity. Dissert. Abstr.

N68-37526# Mound Lab., Miamisburg, Ohio.
CHEMISTRY AND PHYSICS Progress Report, Jan. 1968–Mar. 1968
29 Mar. 1968 42 p 38 refs
(Contract AT(33-1)-GEN-53)
(MLM-1494) CFSTI: HC $3.00/MF $0.65

Research progress is reported on: the α–β branching ratio of ^{227}Ac, neodymium preparation, characterization of heavy-metal-inorganic ion exchange systems, ^{234}U recovery, ^{229}Th recovery, ^{206}Pb recovery, decay scheme of ^{210m}Bi, internal conversion electron and gamma transitions in ^{227}Ac, excited states of ^{21}Na, neutron total cross section for ^{16}O, and reworking of a lithium-drifted germanium detector. NSA

N68-37528 North Texas State Univ., Denton.
DISCONTINUOUS THERMAL EXPANSIONS AND PHASE TRANSFORMATIONS IN CRYSTALS AT HIGHER TEMPERATURES
Yuan Tsun Hsu (Ph.D. Thesis) 1967 118 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2775

Fourteen compounds have been studied by X ray diffraction measurement from room temperature to their melting points or to a 600°C maximum. The purposes of this investigation are to reveal the discontinuity of thermal expansion; the existence of transformations; the influence of polarizability on thermal expansion; and the anisotropy of expansion. The compounds treated are PbF_2, $PbCl_2$, $PbBr_2$, PbI_2, PbFCl, PbFI, PbClI, NaCl, TlCl, $NaNO_3$, NH_4NO_3, HgI_2, SiO_2, and MgO. Results from the measurements of cell parameters of all the compounds investigated show that expansion is discontinuous with temperature. The number of such changes in a similar temperature range has been observed to depend mainly on the cations of these compounds. An effect of electronic polarizability on thermal expansion has been observed. A new and very simple empirical formula has been deduced to correlate thermal expansion with electronic polarizabilities and atomic weights of the ions of the compounds. Dissert. Abstr.

N68-37532 Colorado Univ., Boulder.
NMR AND THEORETICAL STUDIES OF MOLECULAR COMPLEXES
Dwight Edward Williams (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-2636

The first goal was to determine whether the average induced magnetic field due to the electronic currents generated in a tumbling benzene molecule in a large applied magnetic field is significantly changed by methylation of the benzene molecule and, if so, in what direction. The NMR frequency of the chloroform proton in chloroform-aromatic complexes referred to the uncomplexed proton was experimentally obtained in order to determine this. The second goal was to determine whether the electric field of the aromatic molecule contributes significantly to the properties of various complexes in which the aromatic molecule participates. As stated, it does so contribute to the NMR frequency. The conclusion was that the electric field interaction with dipolar, quadrupolar, and polarizable molecules makes a major contribution to the properties of π-hydrogen-bonded and charge transfer complexes. Dissert. Abstr.

N68-37545 Brigham Young Univ., Provo, Utah.
THERMODYNAMICS OF PROTON IONIZATION IN AQUEOUS SOLUTION: 1. A CALORIMETRIC METHOD FOR THE DETERMINATION OF MICROCONSTANTS: pK, ΔH°, AND ΔS° VALUES FOR PROTON IONIZATION FROM o-, m-, AND p-AMINOBENZOIC ACIDS AND THEIR METHYL ESTERS AT 25°C. 2. THE EXTENSION OF THE ENTROPY TITRATION METHOD TO INTERMEDIATE p-K RANGES $pK > 4 < 10$. 3. pK, ΔH°, AND ΔS° VALUES FOR PROTON IONIZATION FROM PROTONATED AMINES AT 25°C
Donald Prior Wrathall (Ph.D. Thesis) 1968 390 p
Available from Univ. Microfilms: HC $17.55/Microfilm $5.00 Order No. 68-2766

Calorimetric ΔH° values are given for stepwise proton dissociation from the protonated o-, m-, and p-aminobenzoic acids together with ΔH° values for proton ionization from the three corresponding methylaminobenzoates. The pK_1 values for the m- and P-aminobenzoic acids and pK values for the methylaminobenzoates were determined both by the entropy titration procedure and by the pH titration method. It is shown that the entropy titration method can be extended using weak acid or base solutions as titrants to cover the intermediate pK range ($4 > pK > 10$). To illustrate the applicability of this method using a weak acid titrant, pK, ΔH°, and ΔS° values for proton ionization from metanilic acid, pyridinium ion, imidazolium ion, protonated tris (hydroxymethyl) aminomethane and glycine have been determined from calorimetric titration data using a solution of acetic acid as titrant. A calorimetric study has been made of proton ionization from 71 protonated amines in aqueous solution at 25°. The resulting ΔH° values were combined with pK values to calculate ΔS° values. Dissert. Abstr.

N68-37562# Los Alamos Scientific Lab., N. Mex.
THE ENTHALPIES OF SELECTED ELEMENTS IN LIQUID PLUTONIUM
D. F. Bowersox and J. A. Leary 22 Jul. 1968 p 7 9 refs
(Contract W-7405-eng-36)
(LA-3951) CFSTI: HC $3.00/MF $0.65

The relative partial molar heats of solution for selected solutes in liquid plutonium were calculated from solubility data from 700° to 1000°C by the equation, $R \ln N_i = \Delta S_f - \Delta \bar{H}^\circ_i/T$, where R is the gas constant, N_i is the mole fraction of solute i in a saturated solution at absolute temperature T, ΔS_f is the entropy of fusion of i, and $\Delta \bar{H}^\circ_i$ is the sum of the heat of fusion ΔH_f of i and the excess enthalpy of solution. The entropy of fusion for these solutes was taken as 2.3 eu. The calculated relative partial molar heats of solution ($\Delta \bar{H}^\circ_i$ in kcal/mole) are: tungsten, 22.0; tantalum, 16.6; niobium, 11.1; vanadium, 11.0; molybdenum, 10.3; chromium, 9.5; and thulium, 9.2. These heats of solution were correlated with solubility parameters by a constant k determined from the data, so that $\Delta \bar{H}^\circ_i = \Delta H_f + k\bar{V}_i(\delta_i - \delta_{Pu})^2$, where $\bar{V}_i$ is the molar volume of solute i and δ_i and δ_{Pu} are the cohesive factors. Author (NSA)

N68-37586 Northwestern Univ., Evanston, Ill.
A STUDY OF WUSTITE USING THERMOGRAVIMETRIC dc ELECTRICAL CONDUCTIVITY AND TRACER DIFFUSION ANALYSES
Phillip Lawrence Hembree (Ph.D. Thesis) 1967 114 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-3188

The oxide wustite has been investigated by three different experimental techniques: thermogravimetric, d.c. electrical conductivity, and iron tracer diffusion. The thermogravimetric analysis determined the composition of wustite as a function of temperature and oxygen partial pressure. The electrical conductivity of wustite was measured as a function of temperature and composition. The analysis of the electrical data seems to rule out the hopping model

for the electrical conductivity in wustite. The iron tracer diffusion coefficient in wustite was determined under well defined conditions at 1100°C in CO_2–CO gas mixtures. The data show that the tracer coefficient is linearly dependent on the composition of wustite.
Dissert. Abstr.

N68-37617 Southern Illinois Univ., Carbondale.
ORBITAL EXPONENT(S) AND WAVE FUNCTION GOODNESS. 1: THE He_2^+ SYSTEM
Cherng-Maw Wang (Ph.D. Thesis) 1967 300 p
Available from Univ. Microfilms: HC $13.50/Microfilm $3.85 Order No. 68-3912

An investigation of the effect of the orbital parameters in simple approximate wave functions was performed. A simple system, helium molecular ion, He_2^+, was chosen for the study. In the independent particle model without configuration interaction, the basis functions for this species contain a maximum of three different orbital exponents. For various choices of internuclear distance, and energy variation calculation was performed. Most calculations were carried out within the framework of the Valence Bond method, using an antisymmetrized Heitler–London–Slater–Pauling wave function. Bond functions were formed by taka linear combination of the determinantal wave functions. For the purpose of comparison, a calculation of the behavior of a single orbital exponent in a perturbation framework was also carried out.
Dissert. Abstr.

N68-37618 South Carolina Univ., Columbia.
AB INITIO CALCULATIONS OF CRYSTAL FIELD ENERGY LEVELS IN DISTORTED OCTAHEDRAL LIGAND ENVIRONMENTS; A COMPARISON OF THE FREE IONS MODEL AND THE IONS IN A CRYSTAL MODEL
Gayle Stanford Painter (Ph.D. Thesis) 1967 309 p
Available from Univ. Microfilms: HC $13.95/Microfilm $4.00 Order No. 68-3938

In this work the crystal field energy levels are calculated for various ionic models of an octahedral transition metal complex in the independent particle scheme. A comparison is made of results obtained using both the effective core charge model of the transition metal ion core and a diffuse inner shell electron core described by a Hartree product wavefunction of Slater type orbitals. A similar investigation is carried out in order to calculate crystal field energy levels in the field of ligands described by Hartree wavefunctions. The crystal field energy levels of the O_h (and D_{4h}) and D_{3d} basis orbitals have been found as functions of tetragonal and trigonal distortion parameters, respectively, for both point charge and extended charge ligands. In this work the radial part of the 3d wavefunction is approximated by a hydrogen-like function in which flexibility is allowed by using a variable orbital parameter, Z. The problem is formulated by applying the variational principle to Z to minimize the total energy of the complex. Dissert. Abstr.

N68-37621 Washington Univ., Seattle.
INFRARED SPECTRA OF PEROXYDISULFURYL DIFLUORIDE AND CARBON DIOXIDE AT LOW TEMPERATURES
Marilyn Ankeney Parker (Ph.D. Thesis) 1967 81 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-3871

A cryostat which used nitrogen and hydrogen gases in a Joule–Thomson expansion to achieve temperatures down to 16°K has been utilized in taking the infrared spectra of thin carbon dioxide films at 53°K and of matrix-isolated peroxydisulfuryl difluoride and the fluorosulfate free radical at 20°K. The carbon dioxide films were studied in the T_2 and T_3 regions. In each region, as the angle of incidence between the illuminating radiation and the deposition window was changed from the normal, a new absorption whose intensity increased dramatically with angle was observed. An attempt was made to correlate the origin of this absorption with a crystallite shape effect theory and with a longitudinal optic mode theory. The spectra of pure peroxydisulfuryl difluoride, the compound in a nitrogen matrix deposited with the spray-on line at room temperature, and the compound in a nitrogen matrix deposited with the spray-on line at 165°C were studied in the frequency region 210 to 1625 cm^{-1}. While the molecular frequency assignments are fairly unequivocal, two interpretations of the spectra are feasible with regard to the fluorosulfate radical.
Dissert. Abstr.

N68-37622 California Univ., Berkeley.
TERNARY FLUID-PHASE EQUILIBRIA AT HIGH PRESSURES WITH ONE NORMALLY GASEOUS COMPONENT
Raymond Nickolas Fleck (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-59

This work is concerned with a separation process in which a homogeneous liquid mixture is equilibrated with a high-pressure gas to cause the formation of two (or more) liquid phases. The liquid phases are separated and the gas is recovered from each phase by depressuring. A novel apparatus was designed and constructed for determining liquid-liquid-gas equilibria. Features of the apparatus are described. Special methods for sampling gases and liquids under pressure were also developed. The apparatus was used to study the gas phase of two binary systems at 15°C, ethylene-water and ethylen-n-propyl alcohol, and also the liquid phase of the latter binary. It was also used to study five ternary systems containing n-propyl alcohol, water and a compressed gas at 15°C.
Dissert. Abstr.

N68-37625 California Univ., Berkeley.
THE KINETICS AND MECHANISMS OF DIFFUSION OF IRON AND NICKEL IN SINGLE CRYSTALS OF MAGNESIUM OXIDE
Stuart Lawrence Blank (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-35

The diffusion kinetics in the Fe–MgO, NiO–MgO and Fe_2O_3–MgO systems were investigated with particular emphasis placed on the relationship between atomistic mechanisms and structural changes. The occurrence of Fe^{+3} ions in tetrahedral symmetry in the MgO lattice was associated with structural changes that were responsible for variations in the activation energy for diffusion in the Fe–MgO and Fe_2O_3–MgO systems. The presence of chemically created vacancies in all of the systems increased the diffusivities. The diffusion studies showed that in vacuum iron reacts with MgO in the temperature range 1100–1350°C according to the reaction $XFe + MgO \rightleftharpoons Fe_xO + Mg$ |. The diffusion results in the NiO–MgO system in vacuum show no concentration dependence of either the D_o term or the activation energy and are represented by $D = 9.82 \times 10^{-6} \exp(-45.5\ kcal/RT)$. However in air the diffusivity was concentration dependent but the activation energy was found to be constant. The diffusion kinetics in the Fe_2O_3–MgO system were found to obey the relation: $D = 8.83 \exp(-74.6\ kcal/RT)$ in the temperature range 1200–1400°C.
Dissert. Abstr.

N68-37627 California Univ., Los Angeles.
SPIN RELAXATION IN LIQUIDS UNDER HIGH PRESSURE AND SPIN EXCHANGE IN SOLUTION

William Zane Plachy (Ph.D. Thesis) 1967 175 p
Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-3278

The electron spin–spin relaxation time, T_2, has been determined for dilute solutions of vanadyl acetylacetonate (VOAA) under both high pressure conditions and variable temperature conditions from measurements of the VOAA electron spin resonance (ESR) linewidth. Results of comparative studies of high pressure data with the variable temperature data in two solvents, toluene and carbon disulphide are presented. The design and construction of the high pressure ESR bomb built for these experiments is described. Also studied were the ESR linewidths of solutions of diteriary butyl nitroxide (DTBN) in n-pentane and propane under variable temperature conditions at concentrations where the linewidths are broadened by spin exchange. From the nonlinearity of a plot of the linewidths due to spin exchange vs. T/η at high values of T/η we can estimate K, minus two times the inter-radical exchange integral. If the coordination number for DTBN in n-pentane is assumed to be 8 we calculate that $K \cong 6 \times 10^{10}$ sec $^{-1}$ in this solvent. The results for DTBN in propane are similar. Dissert. Abstr.

N68-37629 Princeton Univ., N. J.
THE INTERACTION BETWEEN NICKEL AND MOLTEN LITHIUM NITRATE
John F. Zoeller (Ph.D. Thesis) 1967 96 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2532

The chemical reaction at the interface between solid nickel and molten lithium nitrate has been investigated in a stagnant, isothermal lithium nitrate melt at 400°C and 500°C. The primary reactants are proposed to be nickel and the nitrate ion, and the major product is nickel oxide film on the surface of the nickel. The correlation between the change in weight of the nickel specimens per unit area of nickel was analyzed. The confidence limits were calculated at the 95% confidence level. In terms of the formation of NiO the rates after two hours of contact can be expressed as 7.0×10^{-3} mg. NiO/cm. ^{2}Ni/hr. at 400°C and 4.4×10^{-3} mg. NiO/cm. ^{2}Ni/hr. at 500°C. The data indicate that a nickel oxide film is formed very rapidly when contact between the pure metal and the molten salt is first made. As the film thickens the reaction rate decreases because diffusion of the nickel ions through the film becomes the rate controlling process. Dissert. Abstr.

N68-37633# Oak Ridge National Lab., Tenn.
OXIDATION OF PYROLYTIC-CARBON-COATED FUEL PARTICLES BY LOW CONCENTRATIONS OF WATER VAPOR
J. E. Baker and L. G. Overholser 10 Apr. 1968 55 p
(Contract W-7405-ENG-26)
(ORNL-TM-2199) CFSTI: HC $3.00/MF $0.65

The oxidation of various batches of pyrolytic-carbon-coated fuel particles by water vapor was studied at 1100° to 1400°C using flowing helium-water vapor mixtures having water vapor concentrations of 250 to 1000 ppM and a total pressure of 1 atm. Rates of reaction of water vapor with pyrolytic carbon coatings were determined from continuously recorded weight changes and from analyses of effluent gases for reaction products. Percentage failure of coatings was determined from the quantity of uranium and/or thorium leached by acid from the oxidized coated fuel particles. Differences in oxidation rates were observed for the various batches of coated particles which could not be correlated satisfactorily with properties of the coatings such as density, anisotropy, and crystallite size. Percentages of failed coatings at constant burnoff also varied from batch to batch. Limited data obtained from exposure of silicon carbide coatings and fuel sticks to water vapor are included. Author (NSA)

N68-37649 Nebraska Univ., Lincoln.
ADSORPTION OF NON-POLAR GASES ON POLYSTYRENE
Roger Francis Hoburg (Ph.D. Thesis) 1967 302 p
Available from Univ. Microfilms: HC $13.75/Microfilm $3.90 Order No. 68-743

This work is an investigation of the adsorption of nitrogen and argon on a highly dispersed sample of polystyrene. The study consisted of two parts. The first part was to develop techniques by which reproducible, reversible isotherms could be obtained for the adsorption of argon on polystyrene and then to analyze the resulting data from a thermodynamic standpoint. The sample of polystyrene used in this work was prepared by freeze-drying techniques. Hysteresis was first observed with argon after a reversible nitrogen isotherm had been determined. When the nitrogen measurements were repeated, it was found that this adsorbate also desorbed irreversibly. There was evidence indicating that flushing the sample with argon, prior to the measurement of the 75°K argon isotherm, had opened up the sample exposing interstitial regions which could trap the adsorbing gas. In the case of argon, it was found that after seven days of equilibration at 77°K and a relative pressure of about 0.9 a state of equilibrium was reached. Dissert. Abstr.

N68-37666 Michigan State Univ., East Lansing.
HIGH RESOLUTION ABSORPTION, ZEEMAN, AND MAGNETIC ROTATION SPECTRA OF NITROGEN DIOXIDE IN THE NEAR INFRARED
Melvin Dennis Olman (Ph.D. Thesis) 1967 158 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-4198

The absorption, Zeeman, and magnetic rotation spectra of the (1,0,1) and (2,0,1) vibration-rotation bands of nitrogen dioxide have been obtained. Improved values of the ground state molecular constants of $^{14}NO_2$ and $^{15}NO_2$ have been obtained from an analysis of combined ground state combination differences and microwave transition frequencies. Accurate upper state rotational and centrifugal distortion constants and band origins have been obtained for the (1,0,1) and (2,0,1) bands of $^{14}NO_2$ and $^{15}NO_2$. In addition, the change in the effective spin-rotation coupling constant between the ground and the (2,0,1) vibrational states has been determined for each isotopic species. Theoretical expressions have been found which give the frequencies and transition probabilities for the Zeeman components of absorption transitions at all magnetic fields. The spectra predicted by these expressions match very closely the details of the experimental spectra at all magnetic fields available. Dissert. Abstr.

N68-37670 Missouri Univ., Kansas City.
POLYORGANOISOCYANIDES
Richard Glenn Sinclair, II (Ph.D. Thesis) 1967 181 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-3576

A method has been discovered for polymerizing α-phenylethyl isocyanide to high polymer in excellent yield. The polymerized product has been identified as high polymer by a variety of techniques, including osmometry, viscometry, and light scattering. The latter techniques have revealed typical behavior for high polymer in solution, and number-average molecular weights of the order of 50,000 have been found. Two methods have been discovered to effect polymerization of α-phenylethyl isocyanide. One method employs a dual initiator system consisting of acid coated, powdered glass and a radical source, and the other method employs preformed polymer as a catalyst seed for fresh monomer. The polymerization was not found to occur when either the acid, radical source, or heterogeneous surface was omitted. In addition, the polymerization occurs much more rapidly in n-heptane as reaction solvent than it does in the other solvents investigated. Dissert. Abstr.

N68-37672# Argonne National Lab., Ill.
CHEMICAL PROPERTIES OF THE ELEMENT 104-KURCHATOVIUM [KHIMICHESKIE SVOISTVA ELEMENTA 104-KURCHATOVIYA]
I. Zvara et al 1967 11 p 9 refs From the report JINR-D7-3548 (ANL-TRANS-632) CFSTI: HC $3.00/MF $0.65

Physicochemical principles were investigated in a method for continuous separation and rapid chemical identification of isotopes of some transition elements produced in nuclear reactions by heavy ions. The method is based on the different volatilities of separated anhydrous chlorides of the elements and on different adsorbabilities of their molecules on solid surfaces. By performing experiments on separation of hafnium from lanthanide element isotopes and other products of nuclear reactions, conditions were chosen for comparison of element 104 properties with those of hafnium, known transplutonium elements, and other elements.
Author (NSA)

N68-37680 Maryland Univ., College Park.
MECHANISMS FOR THE THERMAL DECOMPOSITION OF POLYACRYLONITRILE
Stanley Wolfowitz (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3397

The thermal decomposition of polyacrylonitrile was undertaken to try to understand the effect of changes in experimental conditions on the volatile components produced, and to get some idea as to the mechanism of their formation. Vapor phase chromatography, infrared spectroscopy, and nuclear magnetic resonance were used extensively for the identification of the volatile products produced. The pyrolysis was studied at four temperatures, 250°, 300°, 350°, and 400°. The major product produced at each temperature was hydrogen cyanide, and an extensive investigation was carried out in order to get a better idea as to the mechanism of its formation. When polyacrylonitrile was pyrolyzed in the presence of acidic materials, an increase in the mole percent of hydrogen cyanide in the volatiles was found. When the polymer was pyrolyzed in the presence of basic materials a decrease the volatiles was observed. Pyrolyses were also conducted in the presence of potential radical initiators.
Dissert. Abstr.

N68-37681 Michigan State Univ., East Lansing.
ANALYSIS OF THE SPECTRA OF PLANAR ASYMMETRIC MOLECULES, WITH APPLICATION TO HYDROGEN TELLURIDE
Norman Kent Moncur (Ph.D. Thesis) 1967 177 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-4194

The development of the vibration rotation Hamiltonian for a planar asymmetric nonlinear XYX molecule is outlined, and energy expressions are given by which energy levels and other quantities useful in an analysis of the spectra of such a molecule may be calculated. Since the upper vibrational states of some of the bands may interact through a Coriolis type resonance, a modified Hamiltonian is given which includes the necessary interaction terms for a description of these states. A method is outlined by which the theoretical energy expressions can be used in an analysis of spectra, and is applied in the analysis of the absorption spectra of H_2Te near 2900 cm^{-1} and 4050 cm^{-1}. Using proper combinations of molecular constants from the different vibrational states analyzed, the equilibrium constants A_e, B_e, and C_e are obtained from which the equilibrium structure (r_e, θ) of H_2Te is calculated.
Dissert. Abstr.

N68-37687 North Carolina Univ., Chapel Hill.
NUCLEAR MAGNETIC RELAXATION AND OVERHAUSER EFFECTS IN LIQUID CHF_3
John Harvie Chaffin, III (Ph.D. Thesis) 1967 74 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-2164

The longitudinal nuclear magnetic relaxation, self-diffusion, and Overhauser effects in liquid CHF_3 were investigated using the pulsed nuclear magnetic resonance (NMR) technique. The investigation extended over temperatures between the freezing and boiling points of the liquid. Misch metal was used as a getter to remove oxygen from the sample. Values of the contributions to the relaxation due to intra- and intermolecular dipole-dipole interactions and spin-rotational interactions were obtained by interpreting the experimental data on the basis of the theory outlined. The intermolecular dipole-dipole contribution was found to be larger than previous theories had predicted, while the intramolecular dipole-dipole contribution was found to be somewhat smaller than had been calculated. Spin-rotational interactions were found to be important in the case of the relaxation of the fluorine nuclei, but negligible for the relaxation of the protons.
Dissert. Abstr.

N68-37707# Nevada Univ., Reno. Dept. of Chemistry.
A CHEMICAL KINETIC STUDY OF SUBSTITUTION REACTION IN COORDINATION COMPOUNDS INVOLVING TRANSITION-METAL IONS HAVING THE D SUB 8 ELECTRONIC CONFIGURATION Final Report, 1 Nov. 1965–30 Jun. 1968
David J. MacDonald Jun. 1968 6 p
(Grant AF-AFOSR-994-66)
(AFOSR-68-1620; AD-672001)

Detailed studies were completed of the kinetics and mechanisms of the acid hydrolyses of the Ni(II) and Pd(II) complexes with ethylenebisbiguanide. The stability constant for the Ni(II) complex with ethylenebisbiguanidde was determined. Employing a computer program developed from evaluating the ionization constants of ethylene bisbiguanidinium ion, the two acid dissociation constants of squaric acid were redetermined.
Author (TAB)

N68-37724# Naval Research Lab., Washington, D. C.
EFFECTS OF OXIDIZABLE ANION ADSORPTION ON THE ANODIC BEHAVIOR OF PLATINUM, PHASE 1 Interim Report
S. Schuldiner 16 Apr. 1968 13 p refs
(NRL-6737; AD-672011)

The retardation of the hydrogen oxidation reaction, which commences at about 0.7 v (NHE) in sulfuric acid solution, can be modified by the presence of formate ions. Steady-state, potentiostatic measurements were made in formic acid solution and formic acid-sulfuric acid solution, both in the presence and absence of hydrogen. The work showed that at potentials under 1.5 v passivity was due to adsorbed anions rather than adsorbed oxygen atoms, Pt oxides, or free radicals formed by the oxidation of water. Pure formic acid solutions were not passivated below 1.5 v; however, formate ions did retard hydrogen oxidation but not as strongly as sulfate ions. The oxidation of formic acid in solutions containing sulfuric acid was affected by adsorption of both sulfate and formate ions. The retardation of the net oxidation of hydrogen and formic acid in formic acid-sulfuric acid mixtures was less than that of hydrogen in sulfuric acid. In the presence of dermasorbed oxygen, both formate and sulfate ions strongly retard the oxidation of added species. The effect of potential on reaction rate appears to depend on the particular organic species adsorbed and may reflect the potential of zero charge.
Author (TAB)

N68-37742*# Techtran Corp., Glen Burnie, Md.
CHEMICAL ANALYSIS OF SOME TRACE IMPURITIES IN URANIUM DIOXIDE

Kakuzo Tada, Isoo Masuda, Hisayoshi Ichihara, Shinji Sugibayashi, Yoichi Goshi et al. Washington NASA Sep. 1968 19 p 19 refs Transl. into ENGLISH from Toshiba Rebuy (Japan), v. 22, no. 11, 1967 p 1339–1344
(Contract NASw-1695)
(NASA-TT-F-11869) CFSTI: HC $3.00/MF $0.65 CSCL 07B

Results of the determination of trace impurities, such as carbon, chlorine, fluorine, nitrogen and silicon, in uranium dioxide for nuclear fuel is described. The methods of determining these impurities in uranium metal have been modified to be applicable to uranium dioxide. It is found that different size particles obtained by crushing pellets differ in contents (higher in finer particles), and the carbon contents increased by further crushing of coarser particles. Author

N68-37749*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STUDIES ON ETHYLENE OXIDE-FREON 12 DECONTAMINATION AND DRY-HEAT STERILIZATION CYCLES
S. H. Kalfayan, R. H. Silver and B. A. Campbell 15 Aug. 1968 44 p 25 refs
(Contract NAS7-100)
(NASA-CR-97343; JPL-TR-32-1310) CFSTI: $3.00/MF $0.65 CSCL 07C

Several problems related to the ethylene oxide-Freon 12 decontamination process were investigated, including: (1) the quantitative estimation of the ethylene oxide concentration in the decontamination chamber, (2) the possibility of reaction between the gases present in the decontamination chamber, (3) the establishment of adequate air-flushing periods to dissipate the absorbed sterilant gases from the materials, and (4) the determination of moisture content. Results show that (1) gas chromatography can be employed as an analytical method for the quantitative estimation of ethylene oxide, with fairly good accuracy, (2) ethylene glycol and small amounts of HCl are formed in the decontamination chamber, (3) air-flushing periods should be extended to 8 h or more for the effective dissipation of absorbed sterilant gases, and (4) none of the commercial moisture-sensing instruments are satisfactory for determining the relative humidity in an atmosphere of ethylene oxide-Freon 12. The effect of various dry-heat sterilization cycles on a selected number of polymeric materials was also investigated, and the results were compared with those obtained for dry-heat sterilization set forth in the JPL specification. Author

N68-37765 Pennsylvania Univ., University Park.
GAS SORPTION BY SUSPENSIONS OF ACTIVATED CARBON IN WATER
Dilip Sukhlal Mehta (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-15403

A new method of gas transfer has been investigated wherein the gas is contacted by a suspension of adsorbent particles in adsorbent liquid. Activated carbon was used as an adsorbent and water was used as adsorbent in this study. The rate studies were made in a bubbler (500 c.c. capacity) and in a drop-through type sieve plate column. Mass transfer efficiency was studied for carbon dioxide, methane, propane, n-hexane, ethylene, trichlorethylene, butyl alcohol, amyl alcohol, benzene, and toulene sorption in a bubbler. The effect of the concentration of the adsorbent on sorption rate was investigated. The mass transfer performance was predicted using a simple model based on penetration theory. A one plate column was used to make absorption [(ethanol, methanol, acetone, benzene)-air-water] and sorption [(ethanol, benzene)-air-suspension] studies. The sorption results were explained in terms of absorption results which in turn were predicted by a mass transfer model. Dissert. Abstr.

N68-37782 Tulane Univ., New Orleans, La.
AN ANALYSIS OF STEADY STATE PROCESS SIMULATION: FORMULATION AND CONVERGENCE
Howard Carl Kliesch (Ph.D. Thesis) 1967 146 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-4050

Steady-state process simulations are fundamental to the study of plant design alternatives and optimization of chemical and petroleum processes. These processes are composed of complex processing units such as reactors and purification systems and normally require highly nonlinear equations for mathematical representation. Another complicating factor is the frequent existence of one or more recycle streams within the process. In the absence of recycle streams, steady-state process simulations can be computed sequentially through the processing units in a single pass for given specifications of the feed-stocks and processing units. The computations required are usually long, tedious and complex. However, when recycle streams are present, then these long, tedious and complex computations also become iterative. Therefore, a different procedure will be required to formulate and solve process simulations containing recycle streams. This is the process simulation problem. Dissert. Abstr.

N68-37783 Utah Univ., Salt Lake City.
THERMODYNAMICS OF THE Fe-O SYSTEM BY COULOMETRIC TITRATION IN HIGH TEMPERATURE GALVANIC CELLS
Harry Frank Rizzo (Ph.D. Thesis) 1968 238 p
Available from Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-1008

The thermodynamics of the iron-oxygen system was studied by coulometric titration between 800° and 1200°C in a galvanic cell. The anion-conducting solid electrolyte (0.85 ZrO_2 · 0.15 CaO) was fabricated into two cell configurations: (1) a closed-end tube in which air was the oxygen reference potential and source of oxygen for titration, and (b) a cylinder containing the sample electrodes in which Fe + Fe_xO electrodes were the oxygen reference potential and the source of oxygen for titration. The standard free energy of formation for wüstite from iron and oxygen between 540° and 1200°C followed the equation ΔF°_T (cal) = −62,452 ± 46.0 ± (15.127 ± 0.05) T (°K). The standard free energy of reaction for the formation of magnetite from wüstite and oxygen between 900° and 1200°C followed the equation ΔF_T (cal) = −76,522 ± 230.0 ± (30.964 ± 0.17) T (°K). Dissert. Abstr.

N68-37785 State Univ. of Iowa, Iowa City.
VIBRATIONAL RELAXATION OF HARMONIC OSCILLATORS INCLUDING MULTIPLE QUANTUM TRANSITIONS
Larry Lee Northup (Ph.D. Thesis) 1967 96 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2851

This study considers the effect of multiple quantum transition probabilities on the average vibrational energy and the distribution of vibrational level populations for the vibrational-translational, collisional relaxation of a closed system of harmonic oscillators contained in a large excess of chemically inert gas with constant heat bath temperature. The multiple quantum transition probabilities used in the analysis are obtained from the method of the N th order perturbation approximation by Sharp and Rapp for a simplified model of a collinear collision between a harmonic oscillator and another atom or molecule with an exponential interaction potential. Numerical examples for nitrogen oscillators and heat bath molecules with an initial Boltzmann distribution at 290°K and heat bath temperatures from 2000°K to 7000°K are calculated. Dissert. Abstr.

N68-37790*# Commissariat a l'Energie Atomique, Fontenay-aux-Rose (France). Centre d'Etudes Nucleaires.
STUDY OF IMMISCIBILITIES IN THE TRILAURYLAMINE-DODECANE-NITRIC ACID-PLUTONIUM SYSTEM [ETUDE DES IMMISCIBILITIES DANS LE SYSTEME TRILAURYLAMINE-DODECANE ACIDE NITRIQUE-PLUTONIUM]
Jean-Claude Saey Mar. 1968 110 p refs In FRENCH
(CEA-R-3478) CSCL 07D

Phase equilibrium in systems made up of trilaurylamine, dodecane, nitric acid, and tetravalent plutonium is shown by drawing the triangular diagrams. The study of these diagrams provides information concerning the causes of immiscibility. Heterogeneity of the organic mixtures can be related to some characteristics of the components, dipole moment, molecular polarizability, and hydrogen bond exchanging ability. Depending on these, some rules may be established that can be used to make a proper choice of an additive in order to improve the miscibility. Studies were carried out showing possible improvements to the extraction process. Author (NSA)

N68-37812*# Idaho State Univ., Pocatello. Dept. of Chemistry.
THE REACTIONS PERTAINING TO ZINC-SILVER AND CADMIUM-SILVER BATTERIES Final Report
G. Myron Arcand 1 Aug. 1968 47 p 25 refs Prepared for JPL
(Contracts NAS7-100; JPL-951887)
(NASA-CR-97353) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Tracer studies show that the predominant species formed in the electrochemical oxidation of zinc in concentrated KOH is ZnO with less than 5% $Zn(OH)_2$ being present. Cadmium treated similarly produces 50–80% $Cd(OH)_2$. Tracer results confirmed the thermogravimetric measurements. The zinc oxidation mechanism is complex and considerable work is required to clarify the various step involved. Included are thermograms of AgO samples from various sources showing that the thermal behavior depends on the method by which these compounds are prepared. In general, chemically-prepared AgO decomposes more rapidly than electrochemically-prepared material. The decomposition of Ag_2O occurs at significantly different temperatures depending on the source of the samples. Solubilities of AgO and Ag_2O in 10 VF KOH saturated with ZnO are about 4×10^{-4} VF. There is some evidence of a decrease in solubility of AgO with time. The solubility of Ag_2O holds constant over periods up to a month and may increase significantly over a year. Author

N68-37849# Illinois Univ., Urbana. Materials Research Lab.
HIGH PRESSURE MOSSBAUER STUDIES OF THE ELECTRONIC STATES OF IRON COMPOUND
George Kenneth Lewis Jun. 1968 163 p 147 refs
(Contract AT(11-1)-1198)
(COO-1198-551) CFSTI: HC $3.00/MF $0.65

The Moessbauer effect was used as a probe to investigate the electronic structure of some iron compounds as a function of pressure. In four substances, the electronic structure was investigated as a function of temperature and pressure. The experimental apparatus necessary to conduct these investigations was constructed. The compounds studied were $FeCl_3$, $FeBr_3$, $KFeCl_4$, basic ferric acetate, Fe in silicate glass, Fe in phosphate glass, $Fe_2(CO)_9$, and $Fe_3(CO)_{12}$. A pressure-induced ferric to ferrous transition was studied in $FeCl_3$, $FeBr_3$, $KFeCl_4$, and basic ferric acetate. The effect of pressure of the metal ligand wavefunction overlap has been calculated and a possible mechanism for electron transfer is postulated. The effect of temperature on the reduction of the above compounds was also studied. The electronic structure of ferric and ferrous ions in sodium silicate and sodium phosphate glass as a function of pressure was studied. Author (NSA)

N68-37877# Kansas State Univ., Manhattan. Dept. of Nuclear Engineering.
OPTIMAL NEUTRON ACTIVATION ANALYSIS
Norman Dean Eckhoff (Ph.D. Thesis) 1968 197 p 46 refs
Supported in part by Kans. Agr. Exptl. Sta.
(TID-24581) CFSTI: HC $3.00/MF $0.65

Basic principles of neutron activation analysis, formulation of the problem, analysis for estimators, minimum absolute deviation (MAD) estimators, minimization of isotope production costs, optimal time parameters, spectrometer system, neutron source and experimental procedures and results are discussed. A uniform irradiation and counting policy of 15 min irradiation at 50 kw power, 5 min decay, and a 3 min count yielded as much analysis information about a typical agriculture sample as any other policy. Seven elements, Cl, Mn, Mg, Ca, K, Br, and Na, can be determined in routine fashion for many agricultural samples. Gain and baseline stabilization by mathematical shifting of the reference and complex spectra were shown to be very important to the neutron activation analysis problem. Appendixes include: isotope buildup and decay, properties of estimators, maximum likelihood method of estimating parameters, the least squares method, Gauss-Markoff theorem, hypothesis testing, Pontryagin's maximum principle, computer program for the correlation algorithm, computer program for calculation of MAD estimators, and computer program for determination of optimal irradiation and decay times for both constant and exponential flux cases. NSA

N68-37890*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EVALUATION OF A GAS CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF THE TRICHLOROFLUOROMETHANE CONTENT IN THE STARTING POLYOL COMPONENT OF POLYURETHANE FOAM
Francis J. Carlin, Jr. 9 Oct. 1968 27 p
(NASA-TM-X-53792) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A gas chromatographic method for the determination of the trichlorofluoromethane content in a polyol has been evaluated. Certain modifications have been recommended. With these modifications, the method has been found to be satisfactory in the range of 28 percent ± 2 percent trichlorofluoromethane, as required by Specification MB0130-077 (North American Rockwell Corporation material specification for two pound density polyurethane foam). Author

N68-37928# Comitato Nazionale per l'Energie Nucleare, Rome (Italy).
INSTALLATION FOR EXTRACTION IN FLOW SHEET TESTING WITH PLUTONIUM [IMPIANTINO DI ESTRAZIONE PER ESPERIENZE DI FLOW SHEET CON PLUTONIO]
M. Abita, E. Baldini, and G. Piana 1968 17 p In ITALIAN
(RT/CHI(68)11) CFSTI: HC $3.00/MF $0.65

An extraction apparatus is described for use in flow sheet testing with plutonium and, particularly, for observing the amount of decontamination of the uranium by the plutonium. The apparatus permits conduction of experiments with flow sheets under the most diverse operating conditions. Extraction takes place within a glove box arrangement. Transl. by M.W.R.

N68-37952# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 16: THE FLUORINATION OF UO_2 PuO_2 FISSION PRODUCT OXIDE PELLETS WITH FLUORINE IN A 2-INCH DIAMETER FLUID-BED REACTOR

L. J. Anastasia, P. G. Alfredson, M. J. Steindler, G. W. Redding, J. G. Riha et al. Dec. 1967 84 p refs
(Contract W-31-109-ENG-38)
(ANL-7372) CFSTI: HC $3.00/MF $0.65

Fluorination of uranium and plutonium oxides to the volatile hexafluorides was studied in a 2-in.-diam fluid-bed reactor using a fluid bed of refractory alumina and simulated spent-fuel pellets containing UO_2, PuO_2, and nonradioactive fission product (F.P.) oxides. The fluorination conditions required to minimize the retention of uranium and plutonium in the alumina bed, which is discarded as waste from the process, were studied. Two general methods of reacting the pellets were used. In the two-zone method, the pellets were oxidized to fine particles of U_3O_8-PuO_2 in the bottom of the reactor. Simultaneously, the fines were transported by fluidizing action to the upper part of the reactor and there fluorinated to the volatile hexafluorides. The alternative procedure was to pulverize the pellets to fines by oxidation and then to complete the fluorination in a separate step. With either method, approximately 80 to 100% of the uranium and about 20 to 75% of the plutonium in the pellet charge were reacted after completion of the initial fluorination step. More than 99.5% of the uranium charge from the alumina bed could be routinely removed. Plutonium material balances of 97% were demonstrated. NSA

N68-37959# Technische Hochschule Hannover (West Germany).
RESEARCH ON THE APPLICATION OF A PINCH DISCHARGE DURING IMPULSE PHOTOLYSIS [UNTERSUCHUNGEN UEBER DIE ANWENDUNG EINER PINCH ENTLADUNG BEI DER IMPULSPHOTOLYSE]
Max Klenert (Ph.D. Thesis) 1967 166 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

A Z pinch apparatus was used as a light source for photolysis, and efforts were made to attain shorter irradiation exposure times by increasing the intensities. The instrumentation for obtaining the absorption spectra, particularly the rotating-mirror camera, was evaluated during the experiments. Photolysis experiments were conducted in two different spectral ranges with a discharge vessel filled with argon at 0.022 torr. Measurements with hydroquinone and eosine solutions were evaluated for line emission and length of exposure. The experiments showed that the pinch is a suitable light source for photolysis. It was demonstrated that the measured reaction processes can be influenced by the external experimental conditions. Transl. by K.W.

N68-37980# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF SOME ADDITIVES ON THE THERMAL DECOMPOSITION OF AMMONIUM PERCHLORATE [VLIYANIE NEKOTORYK DOBAVOK NA TERMICHESKOE RAZLOZHENIE PERKHLORATA AMMONIYA]
A. A. Shidlovskii, L. F. Shmagin, and V. V. Bulanov Dec. 1967 13 p refs Transl. into ENGLISH from Izv. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), v. 8, no. 4, 1965 p 533-538
(FTD-MT-24-359-67; AD-674692)

The purpose of the work was to investigate the thermal decomposition of ammonium perchlorate (AP) in the presence of oxides, chlorides, carbonates, and oxalates of certain metals. The decomposition was studied gravimetrically, at atmospheric pressure and 214-470C. The following values for activation energies were found: for the orthorhombic form, E = 40 kcal/mole; for the cubic form, E = 36-39 kcal/mole. Compounds of manganese and cobalt promote complete decomposition of AP at T < 240C. Compounds of iron, nickel, and chromium promote complete decomposition of AP at 270-280C. The rate of decomposition of AP is increased by the addition of compounds of copper, manganese, cobalt, as well as zinc oxide; it is retarded by the addition of compounds of iron, bivalent nickel, chromium, and vanadium pentoxide. For the same element, the activity of the compounds added decreases in the following order: Carbonate(oxalate), oxide, chloride. Author (TAB)

N68-37984 Technische Hochschule Hannover (West Germany).
ADSORPTION AND EXCHANGE OF HYDROGEN AND DEUTERIUM IN NICKEL FILMS [ADSORPTION UND AUSTAUSCH VON WASSERSTOFF UND DEUTERIUM AN NICKELFILMEN]
Gert Santelmann (Ph.D. Thesis) 1968 126 p refs In GERMAN
CFSTI: $3.00

Measured were electrical resistance of vacuum deposited 100 Å thick nickel films after condensation and isotope exchanged with hydrogen or deuterium at 77°K, 150°K, 195°K, and 273°K. Electric resistance increased with length of condensation up to chemisorption of the negative polarized atoms. A resistance maximum for hydrogen condensation at 77°K was followed by a drop to a weak plateau before it increased again; with deuterium only a weak drop was noted after maximum resistance was attained. Mass spectrometric determination of exchange isotope equilibria in the gaseous as well as in the deposited film showed that the hydrogen isotope adsorption phase was completely exchanged at 298°K, 273°K, and 195°K. At lower temperatures only parts of the adsorbing molecules released the necessary exchange activation energy. It was concluded that the isotope exchange in nickel films depends on the exchange temperatures. Transl. by G.G.

N68-38005# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ETCHING AND REGROWTH OF CUPROUS CHLORIDE
Armond B. Chase, William R. Wilcox, and James R. Teviotdale Jun. 1968 13 p refs
(Contract FO4695-67-C-0158)
(TR-0158(9230-03)-3; SAMSO-TR-68-281; AD-674757) CFSTI: HC $3.00/MF $0.65

Partial dissolution in hydrochloric acid followed by gentle rinsing in water allowed individual grains and twins in cuprous chloride to be distinguished easily with the naked eye. It was found that regrowth occurred during rinsing because of dissociation of the soluble CuCl2(-) complex. This regrowth resulted in the formation of a shingled surface which served to reflect light quite differently from different grain orientations. Polished surfaces were found to result from etching with 50:50 nitric acid-water for times up to 30 sec at room temperature. Dislocation etch pits were revealed by placing cuprous chloride in hydrochloric acid for times up to 5 sec followed by spraying with acetone. Author (TAB)

N68-38012# Oak Ridge National Lab., Tenn.
ISOTOPIC CHROMATOGRAPHY [CHROMATOGRAPHIE ISOTOPIQUE]
C. Jousselin and C. Massot [1968] 134 p Transl. into ENGLISH from a French report
(ORNL-TR-1950) CFSTI: HC $3.00/MF $0.65

Calculations that describe experimental results in elution chromatography are presented. It is shown that chromatography increases the enrichment obtained by simple adsorption according to the basic relation: $\rho^* = R\,(\Delta A/A)$, where ρ^* is the chromatographic enrichment factor and R is the resolving power of the column. Quantitative chemical calculations are presented, which allow evaluation of the relative difference in the absorption coefficients in simple cases. The exact numerical solution of the general problem is given. NSA

N68-38069# Office of Naval Intelligence, Washington, D. C. Translation Div.
NITROGEN ISOTOPE SEPARATION BY MEANS OF CHEMICAL EXCHANGE USING COMPLEX FORMATION [RAZDELENIE IZOTOPOV AZOTA METODOM KHIMICHESKOGO OBMENA S ISPOLZOVANIEM KOMPLEKSOOBRAZOVANIYAO]
A. I. Kuznetsov, A. V. Makarov, and G. M. Panchenkov 21 May 1968 10 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 40, no. 9, 1966 p 2133–2136
(NIC-TRANS-2608; AD-674818)

As an example of a two-phase system, ammonia and the complex compound of ammonia with n-propanol demonstrates the possibility of isotopic separation of nitrogen using the method of chemical exchange using complex formation. An automatic apparatus is described for the isotopic separation by the method of chemical exchange, using the method of thermal reversibility between phases. For the system NH3 - NH3.C3H7OH in a 1.5 meter column at 6C., and with a rate of addition of the complex of 1.0 ml/min over 8 hours, a coefficient of separation of 1.489 was obtained, whereby 15N was concentrated in the liquid phase.
Author (TAB)

N68-38072# Office of Naval Intelligence, Washington, D. C. Translation Div.
SEPARATION OF A BINARY MIXTURE OF ISOTOPES IN AN ION-EXCHANGE COLUMN BY SUPERIMPOSING A CONSTANT ELECTRIC FIELD [RAZDELENIE BINARNOI SMECI IZOTOPOV V IONOOBMENNOI KOLONKYE S NALOZHENIEM POSTOYANNOGO ELEKTRICHESKOGO POLYA]
M. N. Kurin, I. A. Tikhomirov, and G. S. Tikhonov May 1968 14 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 40, no. 9, 1966 p 2177–2184
(NIC-TRANS-2607; AD-674821)

A differential equation was set up for the process of separation of isotopic ions in the case of an ion exchange column with a superimposed constant electric field. The equation thus obtained permits the calculation of the time for establishment of a stationary condition, the value of the HETP, and the concentration distribution of light- and heavy-weight isotopes both in solution and throughout the length of the column. The experimental and calculated data correspond very well with each other, which confirms the accuracy of the assumptions made in setting up the differential equations.
Author (TAB)

N68-38103# New York Univ., N. Y. Research Div.
RESEARCH ON THE PREPARATION OF PURE METALS Final Report, 16 Mar. 1963–15 Jan. 1967
Walter Brenner and Yoshiyuki Okamoto Feb. 1968 232 p refs
(Contract AF 19(628)-2359)
(AFCRL-68-0151; AD-674766) CFSTI: HC$3.00/MF$0.65

Experimental studies on the preparation and characterization of various electronically interesting inorganic and organic elements and compounds are described. In the inorganic phases of these investigations emphasis was placed on the synthesis and the characterization of certain selected elements and binary compounds in high purity by specific reactions involving the preparation and subsequent decomposition of metal hydrides, azides and other unstable intermediates. Data are presented on the synthesis and characterization of high purity yttrium, nickel, cobalt, manganese as well as gallium nitride, gallium and aluminum phosphide. Exploratory studies were also conducted on the preparation of single crystal films of selected group II-VI compounds, again via the decomposition of various unstable intermediates. Experiments with candidate organic semiconductor materials were directed towards developing a better understanding of the relationships between chemical structure and electronic conductivity with emphasis on polymeric materials because of their superior thermal and chemical stability. The preparation and electronic properties of the polyhalopyridines and selected charge transfer complexes thereof are described in some detail. Data are also presented on polypridyl acetylenes, phenyl polymers, polyesters, polycyanogen and certain specially synthesized pyridine polymers as well as a number of modified vinyl polymers.
Author (TAB)

N68-38120 Technische Hochschule Hannover (West Germany).
MOLECULAR BEAM SAMPLING FOR INVESTIGATION OF REACTIONS IN THE GAS PHASE [MOLEKULARSTRAHLPROBEENTNAHME ZUR UNTERSUCHUNG VON REAKTIONEN IN DER GASPHASE]
Martin Witthaus (Ph.D. Thesis) 27 Mar. 1939 118 p refs In GERMAN
CFSTI: $3.00

An arrangement for the continuous analysis of gas mixtures or for monitoring chemical reactions in the gaseous phase has been developed. In this process, the gaseous reaction mixture is channeled into a molecular beam which transports the gas particles to the ion source of a mass spectrometer in less than a millisecond. The equipment consists of a reactor, the sampling device, the analyzer, and a signal amplifier. Construction of the molecular beam equipment, adaptation of the quadrupole mass filter to the molecular beam measurements, and installation of the chopper amplifier are described. Optimal operating conditions of the system are discussed. Mass-spectrometric analyses were conducted in which the radicals produced by photolysis were determined.
Transl. by K.W.

N68-38140# Louvain Univ. (Belgium). Physical Chemistry Lab.
STUDY OF CRYSTALLINE COMPLEXES BY X-RAY DIFFRACTION: ALKALI HALIDES COMPLEXES AND IRON-CARBONYL DERIVATIVES [ETUDE DE COMPLEXES CRISTALLINS PAR DIFFRACTION DE RAYONS X: COMPLEXES D'HALOGENURES ALCALINS – DERIVES DU FER-CARBONYLE]
Paul Piret (Ph.D. Thesis) 1968 142 p refs
CFSTI: HC$3.00/MF$0.65

The classical methods of X ray structural analysis are reviewed. The results of the 17 alkali halide complexes and iron carbonyl chelates studied are summarized and include lattice parameters and angles, Z, incident radiation used, spatial groups, crystallographic density, and detailed structural configurations and determinations. Complex formation, types of structures, linkages, and constituent influences on structure are theoretically considered for the alkali halides. The symmetry and structure, interatomic distances, and coordinate transformations of metal carbonyl complex coordinates are discussed.
Transl. by B.P.

N68-38146# Michigan Univ., Ann Arbor. Dept. of Chemistry.
FORMATION OF REACTION INTERMEDIATE COMPLEXITIES Final Technical Report, 1 Sep. 1964–31 Aug. 1967
Harry B. Mark, Jr. Aug. 1968 13 p refs
(Contract DA-31-124-ARO-D-284)
(Rept.-06880-1-F; AD-674233) CFSTI: HC$3.00/MF$0.65

A summary is given of a research program which involved application of internal reflectance spectroscopy techniques to problems in electrochemistry. A listing of the 18 papers published as a result of the work is included.
TAB

N68-38154# Wisconsin Univ., Madison. Mathematics Research Center.
A NONLINEAR SINGULAR PERTURBATION PROBLEM ARISING IN THE STUDY OF CHEMICAL FLOW REACTORS
R. E. O'Malley, Jr. Feb. 1968 20 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-847; AD-674458) CFSTI: HC $3.00/MF $0.65

The paper presents a method of obtaining the complete asymptotic solution of boundary value problems of the form epsilon y - b(x)y - g(s,y) = 0; ey(0) = y(0) - alpha; y(1) = beta for x epsilon (0,1) where b(x) is strictly positive and for epsilon small and positive. Physically, the problem arises in determining the steady-state concentration of a substance in a chemical flow reactor. A two-variable expansion procedure is used. Author (TAB)

N68-38228# General Electric Co., Philadelphia, Pa. Missile and Space Div.
OPTICAL ENERGY TRANSFER PROCESSES Final Report
M. J. Linevsky Jul. 1968 33 p refs
(Contract DAHC04-C-0065; ARPA Order 1009)
(AD-673937) CFSTI: HC $3.00/MF $0.65

Experimental and analytical investigations have been carried out on photo-excitation and ionization processes in barium and titanium systems. It has been shown that, in order to explain the observed rates of photoionization of barium clouds, photoionization involving barium metastables must be assumed. Population of these metastables can be achieved through an optical pumping process involving resonance absorption from the ground state followed by branching into the metastable levels. A quasi-steady state analysis of this process indicates that an f number of approximately 0.1 is necessary to explain the observed rates of ion production in the barium clouds. Experimental studies using both optical absorption techniques and photo-ionization mass spectrometry indicate this f number to be in the range of 0.01 to 0.1. Author (TAB)

N68-38229# Little (Arthur D.), Inc., Cambridge, Mass.
IONIC DIFFUSION UNDER HIGH PRESSURE IN POROUS SOLID MATERIALS PERMEATED WITH AQUEOUS, ELECTROLYTIC SOLUTIONS
R. A. Horne, A. F. Day, and R. P. Young 30 Aug. 1968 27 p refs
(Contract Nonr-4424(00))
(TR-37; AD-674116) CFSTI: HC $3.00/MF $0.65

The effect of pressure on ionic diffusion in aqueous KCl and MgSO4 solutions and KCl in ethanol-water solution through a microposous glass disk at 25 degrees C is small. The present experiments yielded the relative rates of diffusion only, and the results obtained do not distinguish between diffusion processes comparable to those in bulk water and much slower diffusion through pressure-stable highly structured interfacial water. Author (TAB)

N68-38240# Little (Arthur D.), Inc., Cambridge, Mass.
TRANSPORT PROCESSES IN AND THE STRUCTURE OF AQUEOUS ELECTROLYTIC SOLUTIONS Final Report
R. A. Horne 30 Aug. 1968 33 p refs
(Contract Nonr-4424(00))
(AD-674407) CFSTI: HC $3.00/MF $0.65

A summary is given of the results of a research program which involved the following topics: Normal electrical conductivity in aqueous solutions at one atmosphere; protonic conduction in aqueous solutions at one atmosphere; normal electrical conductivity in aqueous solutions under high hydrostatic pressures; high pressure viscosity measurements; ionic hydration; hydrophobic hydration; interfacial water structure; applications to underwater sound, oceanography, rheology, and biology. TAB

N68-38265# Universite Lovanium, Leopoldville (Congo).
PERFECTION OF AN IRRADIATION TECHNIQUE OF LIQUIDS AND GASES BY ACCELERATED ELECTRONS. APPLICATION TO RADIOLYSIS OF NORMAL LIQUID PENTANE [MISE AU POINT D'UNE TECHNIQUE D'IRRADIATION DES LIQUIDES ET DES GAZ PAR DES ELECTRONS ACCELERES. APPLICATION A LA RADIOLYSE DU PENTANE NORMAL LIQUIDE]
P. Claes 1966 158 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

The principal radiations used in radiation chemistry are reviewed with respect to types, intensity, dosage effects, nature of active species, transfer energy, and differences among natural or artificial radioelements or accelerated particles. An apparatus was constructed for electron energy irradiation of liquids and gases between 10 and 50 KV; it has a discharge energy of 10^7 rad/sec. Normal pentane, hydrocarbons, nitrous oxide, ferrous oxide, and oxalic acid were analyzed for use as potential chemical dosimeters in the irradiation apparatus. Results are tabulated and methods for analysis discussed. Physical characteristics of dosimetry are reviewed, and a comparison is made with the chemical methods. A detailed study of the radiolysis of liquid pentane was carried out. The results show that the speed of hydrogen production diminishes with increasing dosage. A mathematical model is derived for the reaction mechanism. Transl. by B.P.

N68-38289# Office of Naval Intelligence, Washington, D. C.
ACCELERATED METHOD OF MEASURING THE CONCENTRATION OF NATURAL AEROSOLS IN A SOLID DISPERSION PHASE WITH HIGH ATMOSPHERIC HUMIDITY [USKORENNYY METOD IZMERENIYA MONTSONTRATSII YESTESTVENNYKH AEROZOLEY S TVERDOY DISPERSNOY FAZOY PRI POVYSHENNOY VLAZHNOSTI VOZDUKHA]
S. P. Belyayev 3 Jul. 1968 7 p Transl. into ENGLISH from Gigiena i Sanit. (Moscow), p 64-67
(ONI-TRANS-2648; AD-674487) CFSTI: HC $3.00/MF $0.65

Determination of the weight concentration of aerosols under natural conditions possesses a number of specific characteristics. The concentration of natural aerosols is ordinarily subjected to sharp oscillations; therefore, a more detailed study requires minimum sampling time. The frequent appearance of an excess of moisture in the atmosphere places special demands on the filter material. Author (TAB)

N68-38302 Ministry of Technology, London (England).
DINITROAMINES IN MANNICH CONDENSATION. PAPER 3: CONDENSATION OF DINITROAMINES WITH ALKYLENEDIAMINES AND FORMALDEHYDE
S. S. Novikov and A. A. Dudinskaya Oct. 1968 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR, Ser. Khim. (Moscow), v. 8, 1967 p 1839-1843
(Mintech-T-5787) CFSTI: $3.00

The comparative stability of certain dinitroamines was assessed for different p_H values in acids and alkalies of different concentration. The structure of the products in the interactions probably depends on the stability of the dinitroamines at definite p_H values. Author

N68-38322# Louvain Univ. (Belgium). Lab. for Inorganic and Analytical Chemistry.
IDENTIFICATION OF THE EXCITED CONDITION OF URANYL ION [DE IDENTIFICATIE VAN DE AANGESLAGEN TOESTANDEN VAN HET URANYLION]
S. De Jaegere 1966 154 p refs In FLEMISH Sponsored by Natl. Fund for Sci. Res. and the Fund for Collective Fundamental Sci. Res.

Chemical and structural characteristics of the uranyl ion are examined, including hydrolysis and stability, linearity and vibration spectra, chemical bonds of the uranium atom in uranyl compounds, and uranyl complexes in solution. The electron structure of the uranyl ions with classical as well as expanded valence is discussed. Changes in the vibration spectrum of the uranyl in solution and the electron transitions in the vibratory absorption spectrum are analyzed. A detailed account is given of uranyl as an anharmonic vibrator and of the potential energy of the triplet of uranyl. Transl. by K.W.

N68-38327# Joint Publications Research Service, Washington, D. C.
DEVELOPMENT OF CHEMICAL SCIENCES IN POLAND
Włodzimierz Trzebiatowski et al *In its* Transl. on Eastern Europe Sci. Affairs 10 Oct. 1968 p 17-53 Transl. from Nauka Polska (Poland), no. 3, May-Jun. 1968 p 3-24 (See N68-38325 24-34)

Reviewed is the development of basic chemical sciences (i.e., inorganic, organic, and physical chemistry) in Poland during the last two decades. Emphasized is research established at various centers, universities, and state institutes. Development forecasts for future studies (next decade) in inorganic, organic, and physical chemistry are presented. Included is a discussion of funding problems; technology utilization aspects; new educational programs for scientific personnel (doctorial studies); and the critical need for adequate scientific apparatus, chemical reagents, and technical personnel. S.C.W.

N68-38345# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
U-3 ORGANIC LOOP OPERATION AND COOLANT CHEMISTRY, PART 1, MARCH 1963- DECEMBER 1965
J. L. Smee May 1968 67 p refs
(AECL-3070) Available from Atomic Energy of Can., Ltd., Chalk River: $1.50

This report describes in detail the U-3 coolant chemistry from the start of loop operation in 1963 to the end of 1965. The commissioning period lasted 14 months because of two main problems: (1) leakage through pump seals. This was overcome by installation of a cool seal flushing flow; (2) Contamination of the loop with an organic impurity which plated out on cold surfaces and plugged filters. It was removed by continuous purification with Attapulgus clay and filters. A series of fouling experiments showed that: (1) If the water content of the coolant dropped below 100 μg H_2O/g, the fouling potential increased; (2) contact of the coolant with air increased the fouling potential; and (3) radiation, particularly fast neutrons, increased the fouling potential considerably. Author

N68-38363# Illinois Univ., Urbana. Noyes Chemical Lab.
THE DISSOCIATION OF LITHIUM AND SODIUM TETRAMETHYLALUMINATE IN SOLUTION
E. S. Gore and H.S. Gutowsky 19 Jul. 1968 45 p refs Submitted for publication
(Contract N00014-66-C-0010-A04)
(TR-17; AD-674521) CFSTI: HC$3.00/MF$0.65

The proton lineshapes for the CH3 groups of lithium and sodium tetramethylaluminate (LiTMA and NaTMA), observed in the solvents ether, tetrahydrofuran (THF), and 1,2-dimethoxyethane (DME) were used to determine the 27 Al spin-lattice relaxation rate R1. The results are interpreted on the basis of an equilibrium between two kinds of ion pairs, an intimate ion pair in which R1 is large and a solvent separated ion pair in which R1 is small. In ether solution, both LiTMA and NaTMA exist as intimate ion pairs while in DME they exist as solvent separated ion pairs. In the THF solutions, the lineshapes depend significantly upon both temperature and concentration, indicating that significant amounts of both ion-pair species are present. Theoretical equations are derived to fit the observed lineshapes on the assumption that the chemical exchange processes are rapid. From the parameters determined by fitting the lineshapes, estimates are obtained for the relative amounts of the two ion-pair species and also for some of the thermodynamic functions describing the equilibrium in the LiTMA-THF and NaTMA-THF solutions. Author (TAB)

N68-38369# California Univ., Livermore. Lawrence Radiation Lab.
CROSSLINKING POLY(2,2-DINITROPROPYL ACRYLATE) IN PLASTIC-BONDED EXPLOSIVES
Duncan E. Dodds and Eugene R. Bissell Mar. 1968 20 p refs
(Contract W-7405-eng-48)
(UCRL-50434) CFSTI: HC$3.00/MF$0.65

Poly(2,2-dinitropropyl acrylate) (DNPA) was crosslinked in RX-09 formulations by esterifying carboxyl groups on polymer chains with a diepoxide. Carboxyl groups were introduced on the polymer chain by copolymerizing DNPA monomer with acrylic acid or by hydrolyzing some of the ester groups in DNPA. RX-09 formulations were prepared by aqueous slurry, which involved the addition of an ethyl acetate solution of the binder system and bis(2-fluoro-2-2-dinitroethyl) formal (FEFO) to an aqueous dispersion of 1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazacyclooctane (HMX). Crosslinking the DNPA reduced the creep of RX-09 by about 20% when the DNPA contained 17.3 mole % carboxyl group. Beam band and compressive strengths of RX-09 were increased by crosslinking DNP containing 6.0 mole % carboxyl groups. Author (NSA)

N68-38427# Universite Lovanium, Leopoldville (Congo).
CYCLOADDITION REACTIONS OF CARBENES. STUDY OF THE REACTIONAL MECHANISM AND OF APPLICATIONS TO ORGANIC SYNTHESIS [LES REACTIONS DE CYCLOADDITION DES CARBENES. ETUDE DU MECANISME REACTIONNEL ET DES APPLICATIONS A LA SYNTHESE ORGANIQUE]
Leon Ghosez 1966 172 p refs In FRENCH
CFSTI: HC$3.00/MF$0.65

Cycloaddition reactions involving carbenes are considered in relation to organic synthesis. It is noted that the term carbene is not restricted to divalent carbon, but includes organometallic complexes with properties similar to those of free carbenes, and that the structure of the carbenes depends primarily on the experimental conditions under which they are formed. Free methylene formation, electron states and reactions, and methylene complexes were considered; as was formation of dihalocarbenes during elimination reactions, including hydrolysis of chloroform and other haloforms, decomposition of trihaloacetic esters, and thermal eliminations of such compounds. The mechanism of cycloaddition was studied in relation to the synthesis of olefins and the determination of the structure of the addition products. Addition of dihalocarbenes to various alkenes and bicyclic olefins was also studied. Molecular rearrangement of certain dicyclopropanes was considered, and a new method is presented for lengthening the molecular chain is presented. Cycloadditions to various cetocarbenes was investigated, and the decomposition of diazoacetophenols in benzonitrile was studied. Transl. by M.W.K.

N68-38433# Windsor Univ. (Ontario). Dept. of Physics.
OPTICAL PUMPING IN ALKALI METAL VAPORS Final Report, 1 Feb. 1967-31 Jan. 1968
L. Krause Feb. 1968 6 p refs
(Grant AF-AFOSR-361-67)
(AFOSR-68-1768; AD-674000)

A very brief summary is given of studies of excitation energy transfer in alkali metal vapors. A list of the 16 papers resulting from the work is included. TAB

N68-38455# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
MOLECULAR SPECTRA PRODUCED BY COLLISION WITH METASTABLE NOBLE GAS ATOMS
E. Stokes Fishburne Oct. 1968 18 p refs Presented at the 23d Symp. on Mol. Struct. and Spectry., Columbus, Ohio, 3–7 Sep. 1968
(RE-346-J)

Electronic levels of metastable noble gas atoms were excited by electron beam, initially to about 15,000 eV and in subsequent experiments through about 8,000 volts. Difference in electron energy did not effect the characteristics of the observed radiation; and test chamber pressure could be varied from 0 to 1,000 microns. Under these conditions, the excitation process involved high energy electrons rather than the secondary electrons obtained by ionization. Because the Jarrell-Ash 3-meter grating spectrograph used in the initial experiments required up to 8 hours exposure time, a 1/2-meter f/8.3 grating monochromator was used in later experiments. Experiments conducted with Ar–N and Xe–N systems indicated that the transfer of energy can be very efficient, the closeness of the energy levels is very important, and the Wigner spin conservation rule is applicable. The actual mechanism of energy transfer is not understood, although formation of a complex molecule is considered a possibility. M.W.R.

N68-38490# Istituto di Chimica Industriale del Politecnico, Milan (Italy).
VIBRATIONAL SPECTRA OF HIGH POLYMERS Final Technical Report
Giuseppe Zerbi, Mitsuo Tasumi, and Luigi Piseri Jun. 1968 76 p refs
(Contract DAJA-37-67-C-0406)
(AD-674264) CFSTI: HC $3.00/MF $0.65

A new approach to the interpretation of the vibrational spectra of high polymers is presented. An attempt was made to develop a new mathematical technique for the predictions of the spectroscopic behavior of polymers containing a random distribution of mass defects. Polyethylene and its deuteroderivatives were studied. The spectra of several copolymers of different isotopic derivatives of ethylene were predicted and compared with the experimental data. The cis opening of the double bond of ethylene during the polymerisation reaction has been again unequivocally confirmed. A preliminary calculation on the spectrum of poly-(vinyl chloride) containing a random distribution of conformational and configurational defects is presented and compared with the experimental findings. A generalisation is presented of the well known GF method for normal coordinate calculations which can be applied for the calculation of normal vibrations of crystals in three dimensions. A hermitian dynamical matrix in terms of cartesian displacement coordinates is derived starting from a harmonic force constants matrix expressed in terms of the Wilsons internal displacement coordinates. TAB

N68-38494# Denver Research Inst., Colo. Mechanics Div.
STUDY OF SPECTRA OF METAL-OXIDANT COMBINATIONS Final Report, 1 Mar. 1967–1 Mar. 1968
R. M. Blunt Crane, Ind. Naval Ammunition Depot 1 Mar. 1968 118 p refs
(Contract N00164-67-C-0320)
(DRI-3976-6803-F; RDTR-126; AD-673976) CFSTI: HC $3.00/MF $0.65

The time-integrated grating spectra obtained at a dispersion of 14.8A nystrom units per millimeter from flames produced by Mg-Ba(NO3)2, Mg-NaNO3, Mg-Ba(NO3)2 - Sr(NO3)2-TFE, Al-NaClO4-PVC, Al-KClOv-PVC, Al-Sr(ClO4)2-PVC, B-Ba(ClO4)1-PVC, B-KClO4-PVC, Mg-LiClO4-PVC, Mg-NaClO4, at different weight percentages are photographically reproduced. The absorption of the light resulting from its passage through the smoke evolved during combustion has been determined and absorption coefficients tabulated for the smoke from several different compositions and ambient pressures. Author (TAB)

N68-38498# Brookhaven National Lab., Upton, N. Y.
RADIATION AND ORGANIC LIQUIDS
Donald J. Metz Jul. 1968 12 p refs *Its* Lecture Ser. No. 70
(BNL-50110) CFSTI: HC $3.00/MF $0.65

Organic radiation chemistry is considered under the following topics: organic compounds, the liquid state, formulation of the problem, end-product analysis, identification of intermediates, free radicals, ions, and ion-radicals. NSA

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-37441 Ohio State Univ., Columbus.
MUTUAL COUPLING IN A THREE ELEMENT, PARALLEL PLATE WAVEGUIDE ARRAY BY WEDGE DIFFRACTION AND SURFACE INTEGRATION TECHNIQUES
Siegfried Mikuteit (Ph.D. Thesis) 1967 88 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-3030

The mutual coupling in a two- and three-element parallel-plate waveguide array is calculated for the TEM waveguide mode using wedge diffraction and surface integration techniques. The diffraction across the intermediate array element of the three-element array is calculated by surface integration techniques. Calculations of mutual coupling in the two- and three-element array have been experimentally verified for guide widths of 0.288, 0.347, and 0.366λ. The mutual coupling results are presented graphically as a function of waveguide separation up to a maximum of 2.45λ. For three-element mutual coupling two calculated curves are presented. One curve shows mutual coupling without the interaction component due to the intermediate guide and the second includes the interaction component. Total coupling into the center element and the end element of the three-element array is presented for a guide width of 0.347λ and for two guide separations of 0.455λ and 2.28λ. The total coupling is given as a function of excitation phase which, in turn, is directly related to the scan angle. The technique of the analysis is presently limited to the three-element array. Dissert. Abstr.

N68-37552 Houston Univ., Tex.
A STUDY OF OPTIMUM MULTIPLEXING SYSTEMS
Robert Duane Shelton (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-16135

A general model was derived which permits analysis of performance of general multiplexing systems. The model also permits synthesis of many interesting new multiplexing systems. The model was used to determine optimum multiplexing systems for various channels. For an additive white Gaussian noise channel it was shown that only equipment simplicity is important in comparison

of multiplexing system quality. Systems based on orthogonal binary waveforms and real exponentials were proposed as best satisfying this subjective criterion. For a bandlimiting channel prolate spheroidal waveforms were shown to achieve the optimum performance. Such waveforms have other undesirable characteristics. Certain frequency division multiplexing systems can achieve essentially the same bandwidth and are much more attractive from other viewpoints. For a peak limiting channel binary coded waveforms were shown to be optimum. Dissert. Abstr.

N68-37559*# Spacelabs, Inc., Van Nuys, Calif.
SIXTEEN CHANNEL MICROMINIATURE FM TELEMETRY SYSTEM Final Report, 17 Jun. 1965–9 Sep. 1968
8 Oct. 1968 83 p
(Contract NAS9-4614)
(NASA-CR-92340; SR68-1054) CFSTI: HC $3.00/MF $0.65
CSCL 09F

Design, development, and production of two 16-channel FM telemetry systems is described, and problems encountered with a twin-tree oscillator and microcircuits are noted. The oscillator output contained considerable signal at the modulation frequency, and the separation of oscillator and modulation frequencies by filtering was found to be impossible. State-of-the-art was considered too limited to develop the proposed thin film voltage controlled oscillator (VCO) and complexity, component density, and precision encountered when the VCO was reduced to a microcircuit halted this approach. Descriptions are included of both the proposed systems and the actual telemetry system; and, for the latter, details are given for the VCO, pre-emphasis module, calibration and regulator module, composite signal amplifier, mixer amplifier, and power supply. Engineering drawings and system and component specifications are appended, as are results of the diode modulator analysis and VCO test data. M.W.R.

N68-37564 Princeton Univ., N. J.
COMPRESSION OF MARKOV DATA
Thomas Patrick Stanley (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-2519

An analysis is presented of a commonly used redundancy removal algorithm for discrete Markov data. It is shown that some simple analytic results are possible, if the input signals to the data compressor are considered sample functions of a discrete state, continuous time, stationary Markov process. The quantized levels and the random transition times are suggestive of television signals, scanned photographs, and facsimile transmission. A measure of the amount of removable redundancy, the compression ratio, is derived for this class of input signals, as a function of the statistical description of the process and the sampling rate. In the case when the channel transmission is error free, the mean squared error is shown to be an implicit function of the compression ratio to illustrate the amount of redundancy present for a given amount of mean squared error. Dissert. Abstr.

N68-37574 Washington Univ., St. Louis, Mo.
ESTIMATION OF SIGNALS IN NOISE WITH ALMOST PERIODIC ARRIVAL TIMES
Louis N. Medgyesi-Mitschang (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-17170

Woodward's original formulation of signal estimation is generalized to the problem of estimating the unknown parameters of signals contained in a sequence of noisy observations. This generalization leads directly to the sequential estimation problem. Special attention is focused in this investigation on the class of signals, characterized by "almost periodic" arrival times and having arbitrary shapes which may also be unknown, but which can be specified adequately by a finite number of orthogonal basis functions. The term, "almost periodic", is used here to denote that the successive arrival times are expressible in terms of a linear recursion relationship containing a small random term, describing the fluctuations around the average delay between successive signal complexes. Limiting cases of this are considered. Further, it is assumed that each observation contains but one signal, not overlapping with adjacent ones. Dissert. Abstr.

N68-37589 Duke Univ., Durham, N. C.
MATHEMATICAL MODELING AND OPTIMIZATION OF A MONOPULSE RADAR ANGLE CHANNEL
Richard E. Lawson (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-3435

The investigation of different configurations of the monopulse radar angle channel and the subsequent specification and optimization of the most desirable configuration is discussed. The optimization of the specified channel is done with respect to the accuracy of off-axis angle determination for noiseless target signals and then for target signals containing noise. It is accomplished through the development and use of a mathematical model. The mathematical model includes the input signal plus noise, the nonlinear limiting amplifier function, and the phase detector function. The input signal used is one derived from a phased array radar receiver. However, the mathematical model is not restricted to this type input, and with slight modifications can be used for inputs from other type radars. The noise in the phased array radar signal is correlated gaussian noise. Dissert. Abstr.

N68-37594 Iowa State Univ. of Science and Technology, Ames.
SYNTHESIS OF NONUNIFORMLY SPACED ANTENNA ARRAYS
John Philip Basart (Ph.D. Thesis) 1967 66 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-2800

A review of all previous design methods is presented together with a new method that is simple to use and gives very good results. In this new method, a symmetrical array of isotropic radiators with unity amplitudes is assumed. Instead of trying to synthesize a specified array pattern with low sidelobes, the cosine functions in the array function are controlled to keep the sidelobes low. This procedure places less restrictions on the number of elements and their positions. A restriction is placed upon the peaks of the cosine functions so that they do not coincide to form high sidelobes in any portion of the pattern. For $2N+1$ antenna elements, there are $N-1$ equations in N unknowns. To keep the design procedure simple for larger arrays, a graphical method was found that provided the additional expression for the element positions. For a 17-element array a linear relationship was found to exist between the first element position and the sidelobe level. Dissert. Abstr.

N68-37596 Maryland Univ., College Park.
ATTITUDE DETERMINATION BY KALMAN FILTERING
James Lawrence Farrell (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-3358

A minumum variance scheme using magnetic and solar measurements is evaluated in a unified simulation applicable to spinning and nonspinning earth or sun orbiters. The simulation program obtains linearized ensemble statistics of the rotational uncertainties, and also generates a Monte Carlo sample which contains the effects of dynamic and geometric nonlinearities. Specifically, the above mentioned sources of nonlinearity must be minimized through the use of an appropriate dynamical formulation and through methodical restriction of measurement geometry. In

connection with rotational dynamics it is noted that spinning orbiters are naturally associated with an inertial reference, whereas gravity gradient satellites are more readily compared with a local frame. The present unified formulation would presumably be sacrificed in actual operation, then, and the inertial formulation employed herein would be maintained only for spinning vehicles. The accuracy of locally linearized gravity gradient libration equations, used thus far only for verifying numerical integration, supports the concept of a local reference with minimum variance attitude determination for nonspinning satellites. Dissert. Abstr.

N68-37630 Maryland Univ., College Park.
SYNCHRONIZATION OF COHERENT COMMUNICATION SYSTEMS
Frederick William Ellersick, Jr. (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3356

The optimization of the synchronization process for a received signal modulated by a pseudo-noise sequence is considered; the frequency and phase of the carrier and the modulation epoch are not known precisely at the receiver. A general solution to this problem is not found, but a bounding relationship and some useful approximations are obtained. A system oriented analysis of several mathematical optimization techniques demonstrates the need for a more realistic assessment of synchronization system performance. To obtain a bound on system performance for the special case of an uncertainty in frequency only, a modification of the optimal receiver for phase incoherent reception is investigated. An extensive numerical analysis of this receiver yields an upper bound for the function relating per-cell integration time to the probability of correctly locating the synchronization signal. For high signal to noise ratios, useful approximations for Marcum's Q-function are derived and used to obtain an asymptotic approximation for the upper bound. Dissert. Abstr.

N68-37640 Michigan Univ., Ann Arbor.
ESTIMATION OF PHASE DIFFERENCES BETWEEN STOCHASTIC NARROWBAND SIGNALS
Ferrel Gerben Stremler (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17844

The purpose of this paper is to study methods which can be used to estimate stochastic delays in narrowband signals and to determine the limits of accuracy to which this can be done. The signals are assumed to be sample functions of a random process with Gaussian statistics. It is assumed that two such functions are available to the receiver and that these functions are related to each other by a slowly-varying phase shift. These signals are imbedded in additive white Gaussian noise. The task of an optimum receiver is to extract the phase difference, in the presence of both signal and noise, in such a manner that the mean square error is minimized. The criterion of minimum mean square error is convenient mathematically and follows from the theory of maximum likelihood estimation for Gaussian statistics. The method used for choosing an optimum receiver is that of the maximum likelihood estimator, which yields a configuration for a receiver that gives an unbiased estimate of the true phase difference for uncorrelated noise. Dissert. Abstr.

N68-37651 Princeton Univ., N. J.
STOCHASTIC APPROXIMATION METHODS AND THEIR APPLICATION TO PROBLEMS IN COMMUNICATION
Peter Sheung Yuen Tong (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-2526

This work is concerned with a number of problems related to stochastic approximation procedures for seeking the critical points or the roots of a regression function which may be identified as the performance surface of the system under study. Due to the unknown functional dependence and the uncertainty involved in the observations, it is necessary to weigh each individual observation appropriately either by reducing the step size of successive adjustment or by taking the average of an increasing number of observations at each iteration. These two approaches give rise to two different types of iterative procedures. The well known Robbins–Munro process and Kiefer–Wolfowitz process are examples of the first type. Procedures of the second type usually make use of the random fixed point theorems. It is shown that these two methods have similar asymptotic solutions under similar conditions imposed on the regression function. Dissert. Abstr.

N68-37686 Ohio State Univ., Columbus.
A CAVITY-FED CONCENTRIC RING PHASED ARRAY OF HELICES FOR USE IN RADIO ASTRONOMY
Keith Ross Carver (Ph.D. Thesis) 1967 251 p
Available from Univ. Microfilms: HC $11.50/Microfilm $3.25 Order No. 68-2962

The radial cavity feed system is similar to a parallel plate waveguide, except that plane waves are replaced by cylindrical waves. The cavity is centrally excited and the plate spacing is typically one eighth wavelength. The array elements are coupled to the radial cavity by means of short linear probes. An experimental quadrant cavity feed system distributing power to 14 modified helices was successfully built and tested. Measured far-zone power patterns agree well with calculated patterns, indicating that the feed system is operating as a high Q (lightly loaded) cavity. Beam shifts of $\pm$ 18° have been obtained with this model with typical bandwidths being less than 1%. Calculations indicate that this type of feed system can be extended to several hundred wavelengths diameter with negligible power loss in the walls. In a large array, the number of elements can be reduced by using the deterministic density tapering technique, with or a moderate increase in sidelobe level over that obtained with uniform element spacing. Dissert. Abstr.

N68-37697 Virginia Univ., Charlottesville.
RESOLUTION OF MULTIPLE PULSES BY ENVELOPE FITTING
Charles Mervyn Weant (Ph.D. Thesis) 1967 158 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-3154

The application of Levinberg's method of damped least squares is made to the problem of parameter estimation for overlapping repetitive signals. Parameter probability density distributions are included for both a gaussian pulse signal and a radio navigation signal. Some preliminary results are obtained for propagation of both types of signals, and further investigation of this method of resolution is recommended. Dissert. Abstr.

N68-37712* Houston Univ., Tex. Cullen Coll. of Engineering.
LUNAR LANDING MODULE REFLECTIVITY MODEL
A. Tong and H. S. Hayre Aug. 1967 56 p refs
(Contract NAS9-6760)
(NASA-CR-92342; TR-67-14) CFSTI: HC $3.00/MF $0.65 CSCL 17I

A sinusoidal quasi-periodic component is superposed on a randomly rough component surface in a lunar surface model that represents the regularly existing rough features such as craters, hills, and boulders shown on Surveyor and Orbiter photographs of the moon. The model uses a random variation of spacing between rimmed craters. The near vertical radar return signal based on this model was calculated using the scalar Helmholtz integral; and results were reduced for various conditions including when the randomly varying main crater diameter tends to zero and the random period or distance between crater centers tends to infinity.

Both one-dimensional two-dimensional radar return calculations and their implications are included; the former is considered appropriate for scattering from a short range radar where the beam cross section area is small compared to the surface, whereas the two-dimensional solution is necessary for long range radar return.
M.W.R.

N68-37714*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-52, VOLUME 2 FOR THE PERIOD 1 MAY TO 30 JUNE 1968. THE DEEP SPACE NETWORK
31 Jul. 1968 161 p refs
(Contract NAS7-100)
(NASA-CR-97346; JPL-SPS-37-52, V. 2) CFSTI: $3.00/MF $0.65 CSCL 09F

Mission support, advanced engineering, development and implementation, operations and systems analysis, and technical facilities studies related to the Deep Space Network (DSN) are summarized. Note is made of Mariner V extended mission operations support, and a description is included of the DSN command system. Tracking and navigational accuracy analysis related to the DSN inherent accuracy project is reported; and communications, tracking and data acquisition, and supporting research activities are summarized. A redesign system test series for the communications processor (IBM 7044) is reported at the Space Flight Operations Facility; and various ground and control studies at the Deep Space Instrumentation Facility are reviewed. Antennas, buildings, and utilities are discussed under the technical facilities programs.
M.W.R.

N68-37721# Mitre Corp., Bedford, Mass.
MOTION PARAMETERS FROM SCATTERING MATRIX MEASUREMENTS
Joseph F. A. Ormsby and William T. Payne May 1968 42 p 7 refs
(Contract AF 19(628)-5165; ARPA Order 596)
(MTR-540; ESD-TR-67-626; AD-672007)

Previous efforts to derive motion parameters from monostatic scattering matrix data have been limited by mathematical complexity. An account of these efforts is given. Then a proposed method is described for the case of precession, which allows the simplicity of a geometric approach and avoids approximation in its concept. This method is formulated as a minimization problem with only three of the precession parameters as the arguments. The basic idea is to find a cone on which the spacing of successive positions of the body axis shall be the dynamically correct spacing. Then the two remaining parameters are easily evaluated.
Author (TAB)

N68-37723# Boeing Co., Renton, Wash. Commercial Airplane Div.
AUTOMATIC DIRECTION FINDER SYSTEM PERFORMANCE ANALYSIS
K. E. Johnstone 5 Jun. 1968 94 p 56 refs
(D6-20972; AD-670658)

Several airlines have expressed interest in increasing or maximizing the useable range of the ADF system thus implying that an increase in the quality factor of the sense antenna may be desirable. However, considerable uncertainty currently exists regarding what factor or factors constitute the primary limitation on the performance of the ADF system. There is no guarantee that an increase in ADF sense antenna quality factor would result in a corresponding improvement in overall ADF system performance. The major purpose of this report is to isolate the factors currently limiting system performance and to describe their characteristics. It is a corollary purpose to provide better definition of the ADF receivers sense antenna input parameters and characteristics. The report first considers the various noise sources which may limit system sensitivity, treating in particular a technique for establishing the expected level of atmospheric noise which may be encountered in a given aeronautical service. Other noise sources are identified and their importance as performance limiting factors is discussed. Following this, measurements of the characteristics of ADF systems in use aboard current aircraft are set forth and discussed.
Author (TAB)

N68-37726# Naval Research Lab., Washington, D. C.
SATELLITE PREDICTION AND DISPLAY: A REVIEW OF SPAD Final Report
H. G. Talmadge, Jr. 12 Jul. 1968 26 p refs
(NRL-6694; AD-673668)

A satellite position prediction and display device (SPAD) has been conceived, constructed, and operated at the Naval Research Laboratory. Experience with the research equipment has shown that it is technically feasible to implement the SPAD concept in several ways, using a digital computer for prediction and using both a geographic display and a tabular readout to present predicted positions of selected satellites at arbitrary times. Other conclusions include the following. Predicted satellite positions should be computed at the users location, using orbital elements and orbit decay information so that prediction can continue even with stale data. The general features of the SPAD computer control panel should be retained, since they provided a great deal of flexibility in presenting predicted positions at arbitrary times for a number of satellites selected either individually or according to category, as fast as such information was requested of the AN/UYK-1 computer.
Author (TAB)

N68-37727*# Colorado Univ., Boulder.
OPTIMUM LINEAR ADAPTIVE DESIGN OF DOMINANT TYPE SYSTEMS WITH LARGE PARAMETER VARIATIONS Semiannual Status Report, Period Ending 30 Sep. 1968
Isaac Horowitz 1 Oct. 1968 10 p 1 ref
(Grant NGR-06-003-083)
(NASA-CR-97312) CFSTI: $3.00/MF $0.65 CSCL 09F

Continued studies conducted under research projects focusing on the following are reported: (1) the use of a third-order dominant model for improved linear adaptive design of dominant type systems with large parameter variations; (2) the use of a fourth-order model for improved linear adaptive design of dominant type systems with large parameter variations; (3) computer aided synthesis of third-order linear systems with large parameter variations; (4) computer programs for synthesis of fourth-order (nondominant) linear systems with large parameter variations; (5) the development of a frequency response approach to the design of linear systems with large parameter variations; (6) studies of feedback systems with simple nonlinearities for the purpose of developing a synthesis approach; (7) decoupling of the limit cycle mode and the adaptive loop transmission mode of the self-oscillating adaptive system (SOAS); and (8) parameter variations in optimal control systems.
S.C.W.

N68-37825# Advisory Group for Aerospace Research and Development, Paris (France).
RADIO WAVE PROPAGATION
Jul. 1968 383 p refs Presented at the Electromagnetic Wave Propagation Comm. of the Avionics Panel, Leicester, 30 Jun.-5 Jul. 1968
(AGARD-LS-29) CFSTI: HC $3.00/MF $0.65

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1. MAGNETO-IONIC THEORY OF RADIO PROPAGATION
K. Davies (Environ. Sci. Serv. Admin., Boulder, Colo.) 92 p (See N68-37826 24-07)

2. THE IONOSPHERE B. Landmark (Norweg. Defence Res. Establ., Kjeller) 48 p refs (See N68-37827 24-13)

3. IONOSPHERIC PROPAGATION OF HIGH FREQUENCY RADIO WAVES W. Dieminger (Max-Planck-Institut Fur Aeronomie, Lindau Uber Northeim, West Germany) 86 p refs (See N68-37828 24-07)

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5. TROPOSPHERIC PROPAGATION OF VHF-UHF WAVES R. Bolgiano, Jr. (Cornell Univ., Ithaca, N. Y.) 29 p refs (See N68-37830 24-07)

N68-37826# Environmental Science Services Administration, Boulder, Colo. Space Disturbances Lab.

MAGNETO-IONIC THEORY OF RADIO PROPAGATION

Kenneth Davies *In* AGARD Radio Wave Propagation Jul. 1968 92 p refs (See N68-37825 24-07)

Properties of propagating waves, magnetoionic theory, ionospheric radio waves, and ray tracing are treated. Anisotropic, dispersive, and absorptive propagation processes are discussed; as are the integration of phase, group, and absorption coefficients and wave polarization. Plane electromagnetic waves that are free in an isotropic or anisotropic dielectric and in a cold magnetoplasma are discussed. Refractive index formulas are given in quasi-transverse and quasi-longitudinal approximations for both ordinary and extraordinary waves; as are refractive index approximations for very low frequencies. In each case, it is assumed that there are no collisions. Reflection, dispersion, and absorption properties are also discussed; and appropriate formulas are evolved. Virtual height, phase change, and frequency variation formulas are included; and Faraday rotation is discussed. Quasi-parabolic and parabolic layer theory formulas are evolved for ray tracing without magnetic fields; and Booker's quartic and Hazelgrove's equations are presented for the case with magnetic fields. M.W.R.

N68-37828# Max-Planck-Institut fur Aeronomie, Lindau Uber Northeim (West Germany).

IONOSPHERIC PROPAGATION OF HIGH FREQUENCY RADIO WAVES

Walter Dieminger *In* AGARD Radio Wave Propagation Jul. 1968 86 p 63 refs (See N68-37825 24-07)

Conversion of vertical to oblique incidence, oblique incidence and backscatter observations, transmitting and receiving problems at high frequency, and ionospheric propagation prediction are considered. Attention is given to vertical and oblique incidences, including theorems of equivalent path and absorption, transmission curves, multipath propagation and magnetoionic splitting, and maximum and lowest usable frequencies. Techniques, practical results at various distances, and correlation with solar and geophysical phenomena is considered for the oblique incidence and backscatter. The use of dipole and directional antennas is discussed, as are aspects of reciprocity, polarization, and great circle deviation at high frequencies. Various types of fading are reviewed, and mention is made of extraterrestrial and atmospheric radio noise. Numerical mapping, signal strength, and calculation procedures for intermediate and long distance communication are discussed as are aspects of prediction management, broadcasting of predicted sunspot numbers, and warnings related to ionospheric prediction. M.W.R.

N68-37829# Defence Research Telecommunications Establishment, Ottawa (Ontario). Radio Physics Lab.

LOW AND VERY LOW FREQUENCY RADIO WAVE PROPAGATION

John S. Belrose *In* AGARD Radio Wave Propagation Jul. 1968 118 p refs (See N68-37825 24-07)

Amplitude, polarization, and phase variations are treated in relation to low frequency radio wave propagation; and details are included for both the normal and irregular behavior of ionospheric propagation of long radio waves over distances of less than 2,000 km. For normal behavior, amplitudes at midday and midnight are discussed in terms of frequency dependence, solar cycle influence, and seasonal variation. Diurnal variation is also noted, as are fading of waves during the day and night. Sudden ionospheric disturbances associated with solar X-ray events, polar cap disturbances associated with solar cosmic radiation, and propagation anomalies associated with high energy particle events are among the irregular behavior events considered. The ionospheric D region and low frequency propagation are described, including calculation of ionospheric reflection properties and long wave reflection from the D region. Measurement of polarization is considered in an oscillating loop experiment, and calculation of sky waves field for low frequency waves obliquely reflected from the ionosphere is detailed. M.W.R.

N68-37830# Cornell Univ., Ithaca, N. Y.

TROPOSPHERIC PROPAGATION OF VHF-UHF WAVES

Ralph Bolgiano, Jr. *In* AGARD Radio Wave Propagation Jul. 1968 29 p 11 refs (See N68-37825 24-07)

The refractive index structure of the troposphere is discussed in relation to the propagation of VHF-UHF waves; and consideration is given to reflection and refraction on line-of-sight paths, radio ducting in the troposphere, and scatter phenomena in troposphere propagation. Pressure, temperature, and moisture profiles are reviewed for the troposphere; and refractivity profiles are discussed in terms of standard refraction, methods of analysis, and a modified refractivity index. Horizontal structure and small-scale deviations are described, including strain by shear and mixing by fully developed turbulence. In connection with line-of-sight paths, elementary reflection, the spherical earth, and nonuniform refraction are discussed. Waveguide ducting, modes of tropospheric radio ducting, and leaky ducts are noted. Scatter phenomena in tropospheric propagation is reviewed, including the effects of small deviations in the refractive index, details the problems associated with scintillations, and considers off-forward scatter. M.W.R.

N68-37833*# Spacecraft, Inc., Huntsville, Ala.

PROGRAMMABLE PREMODULATION FILTER FOR MANNED SPACECRAFT CENTER Final Report, Apr. 1967-Jun. 1968

Jun. 1968 36 p

(Contract NAS9-6929)

(NASA-CR-92346) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Objectives and achievements accomplished under a program focusing on the design, manufacture, and type qualification of programmable premodulation filters which meet or exceed specification requirements for a signal conditioner that accepts a NRZ pulse code wavetrain and filters out undesirable frequencies. Reported are circuit design, mechanical design, engineering evaluation, type qualification testing, and flight qualification test data. Also included are data on operating instructions. It is concluded that as a result of the design and test programs the design of the unit meets all of the specification requirements and is a manufacturable unit. S.C.W.

N68-37837*# RAND Corp., Santa Monica, Calif.

THE TECHNOLOGY POTENTIALS FOR SATELLITE SPACING AND FREQUENCY SHARING

J. L. Hult, S. J. Dudzinsky, N. E. Feldman, J. D. Mallett, N. C. Ostrander et al Oct. 1968 157 p refs

(Contract NASr-21)

(NASA-CR-97310; RM-5785-NASA) CFSTI: HC $3.00/MF $0.65 CSCL 17B

System parameter constraints that could improve the compatibility of and provide benefits for satellite microwave relay systems sharing a common spectrum were derived. Technological background required for deriving suitable specifications for high performance system design are summarized, as are the satellite spacing and frequency sharing aspects. Message objectives, protections ratios, and their interrelationships are included; and polarization discrimination and propagation factors, earth-to-satellite geometric factors, and reference antenna patterns and ground environment models are discussed. Interference to and from satellites to earth stations is considered; along with other direct interference modes, scatter modes of interference, and combined effects of interference from all modes. Frequency-sharing potential of synchronous orbits, reference antennas and effects of satellite spacing, and frequency dependence of low noise and output devices are discussed. M.W.R.

N68-37873* Adcom, Inc., Palo Alto, Calif.
SATURN TELEMETRY DATA COMPRESSOR TEST PROGRAM Final Report
Carl D. Labmeier 20 Apr. 1968 164 p
(Contract NAS8-21204)
(NASA-CR-98031; G-108) CFSTI: $3.00 CSCL 09F

PCM telemetry data from Saturn Flights AS-202, AS-203 and AS-204 were processed through a zero-order predictor data compressor. Tests initially specified for this test program required revision to avoid buffer memory saturation. Therefore to meet program objectives, several new test programs were generated for each flight. For the three Saturn flights, 153 total test runs were generated to study the buffer memory behavior as a function of the data compressor control parameters. Buffer fullness values were measured from the test run visicorder records and plotted for comparative analysis. A significant difference in data characteristics was observed between the three flights analyzed; as such, commonality between optimum control parameters was not found. Author

N68-37898*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONVERTER FOR GENERATING PULSE-POSITION-MODULATION TELEMETRY DATA FROM BINARY-DIGITAL TAPES (BINARY-TO-PPM CONVERTER)
R. J. Stattel Sep. 1968 31 p 5 refs
(NASA-TM-X-63377; X-721-68-380) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The converter described in this report is used in the Pulse-Position-Modulation (PPM) telemetry ground station of Goddard Space Flight Center's Sounding Rocket Branch. It receives played back data from the station tape recorder. This is nine-bit binary-digital data which was previously converted from the PPM format and recorded. Its output is pulse-position-modulated data. Author

N68-37924# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
PERFORMANCE OF ELECTRO-OPTICAL GUN-BORE TELEMETRY SYSTEMS
Jan H. Helbers Aug. 1968 29 p
(PA-TR-3708; AD-674650) CFSTI: HC $3.00/MF $0.65

In the first section of this report, the theoretical limitations and physical constraints of an electro-optical gun bore telemetry system are derived. The model used for this analysis was based, to the greatest possible extent, on what was believed to be a practical system. Various photpdetectors are rated as to suitability in the system, and conclusions are drawn regarding an optimum selection. In the second section, the experiments conducted to verify the theory are described. The equations relating received power to transmitted power, and the equations used to determine system S/N ratio, are shown to agree very closely with the measured data. Author (TAB)

N68-37987# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberaffenhofen (West Germany). Inst. fuer Satellitenelektronik.
PROPOSAL FOR THE DATA HANDLING OF TELEMETRY DATA OF THE GERMAN SCIENTIFIC SATELLITE AZUR-1 [STUDIE ZUR AUFBEREITUNG DER TELEMETRIE-DATEN DES DEUTSCHEN FORSCHUNGSSATELLITEN AZUR-1]
W. Markwitz Aug. 1968 29 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-54) CFSTI: HC $3.00/MF $0.65

A technical concept for the automatic processing of pulse-code-modulated tememetry-data of the first German Research-Satellite AZUR is described. Telemetry-data will be received and recorded on analog magnetic tapes by ground-stations. To produce compatible tapes for digital computations a conversion-procedure consisting of signal-conditioning, frame-synchronization, time-allocation and error-detection must be performed. The processed data will be recorded on digital computer tapes. Author

N68-37990# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERCEPTION RADAR
Chang Hung 30 Jun. 1967 9 p Transl. into ENGLISH from Hang K'ung Chih Shih, v. 3, no. 2, 1966 p 14–15
(FTD-HT-67-167; AD-668068)

The article discusses the function, features, and future development of airborne fire control radar. The fire control radar is an essential system which makes an intercepter formidable under all weather conditions. Features of an airborne fire control radar include compactness, easy installation, automatic operation, accuracy, and reliability. Trends in fire control radar development are toward multiple weapon control, increase of firing range, use in combination with other systems, miniaturization, and expanded scope of application. TAB

N68-38022# Signals Research and Development Establishment, Christchurch (England)
SOME DIELECTRIC ROD ANTENNA STUDIES
D. Herbison-Evans Aug. 1967 69 p refs
(Rept.-67003) CFSTI: HC $3.00/MF $0.65

Dielectric rod aerials are poorly understood. To begin to rectify this, the Kirchoff approximation was used to derive formulae for the proportion of incident power in the exit HE_{11} surface wave of two arrangements: (1) a waveguide launcher consisting of a circular waveguide loaded with one dielectric feeding a circular dielectric rod of the same radius of another dielectric, (2) a step change in radius and dielectric on a circular dielectric rod. Algol computer programs are presented which evaluate these. The theoretical results are discussed in relation to the design of dielectric rod aerials. Author

N68-38030# Harry Diamond Labs., Inc., Washington, D. C.
DIRECTION SENSITIVE DOPPLER RADAR DEMONSTRATION UNIT
Raymond H. Femenias Jul. 1968 22 p refs
(HDL-TR-1404; AD-674658) CFSTI: HC $3.00/MF $0.65

A cw doppler field radar has been built. The portable unit, intended for demonstration purposes, can detect a man walking at a distance of over 300 ft. Since the radar is of the direction-sensitive type, it discriminates against clutter caused by vegetation moving back and forth with the wind. The system is described and some experimental results are given. Author (TAB)

N68-38034# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE DOPPLER METHOD OF NAVIGATIONAL USE OF ARTIFICIAL EARTH SATELLITES [DOPPLEROVSKII METOD NAVIGATSIONNOGO ISPOLZOVANIYA ISKUSSTVENNYKH SPUTNIKOV ZEMLI]

E. N. Perevezentsev 18 Oct. 1967 19 p Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Morsk. Flota (Leningrad), no. 73, 1966 p 65–76

(FTD-MT-24-247-67; AD-674700)

The orbital parameters and possible spatial positions of satellites in rectangular and spherical coordinates are defined. Fundamental questions of using satellites to determine a ships position at sea by the Doppler method are reviewed. Recommendations concerning the composition and structural arrangement of the ships navigational complex for the reception and processing of orbital information are made. TAB

N68-38048# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.

TWENTY-CHANNEL VERTICAL LISTENING ARRAYS. PART 1: ELECTRICAL FEATURES. PART 2: MECHANICAL FEATURES

Milton Lopatin and Edward T. O'Neill Mar. 1968 84 p

(Contract Nonr-266(84))

(TR-147; AD-674118)

The report is concerned with the electrical and mechanical characteristics of a 20-channel telemetry system using a vertically suspended array. The system was used successfully in three types of configurations, two arrays were bottom anchored while the third was a tethered array launched from an anchored ship. Author (TAB)

N68-38104# Sperry Gyroscope Co., Great Neck, N. Y.

TRANSVERSE ANTENNA FEED STUDY Final Report, 15 Dec. 1965–30 Apr. 1968

R. W. Martin, L. I. Smilen, and P. A. Valentino Bedford, Mass. AFCRL May 1968 152 p refs

(Contract AF 19(628)-5743)

(SGD-4261-0150; AFCRL-68-0279; AD-674061)

The program described in this final report had as its goal the investigation of the transverse focal region field distributions of a Cassegrain reflector antenna, evolving applicable microwave feed networks, and analysis of antenna system performance behavior as a function of the various feed electrical and physical parameters. Author (TAB)

N68-38105*# Philco-Ford Corp., Palo Alto, Calif. Space and Re-Entry Div.

C AND X-BAND COMMUNICATIONS TRANSPONDER AND TRANSPONDER TEST SET Final Engineering Report, 28 Dec. 1965–31 Oct. 1967

31 Oct. 1967 215 p refs

(Contract NAS9-5235)

(NASA-CR-92354; TR-DA-1565) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Tradeoff analyses were conducted in order to select the C- or X-band as the optimum operational frequency range for satisfying the ground-space communications requirements of future manned space flight missions. The results show that communications between spacecraft and ground stations of the Manned Space Flight Network are feasible at near-earth and lunar ranges at either C- or X-band frequencies using state-of-the art spacecraft equipment and unified S-band ground equipment modified for operation at these frequencies. System design details are presented on the transponder, the test receiver, and the test transmitter. Reliability assessments are also included on three modes of operation for the C- and X-band transponder subsystem: receive mode, transmit-noncoherent mode, and the receive and transmit-coherent mode. The problems encountered in the development program, and the solutions found to them, are discussed, and recommendations for improved equipment performance are proposed. M.G.J.

N68-38107# Western Electric Co., Inc., New York.

A COMPARISON OF THREE SCHEMES FOR FILTERING SIGNALS WHICH HAVE PROPAGATED THROUGH A RANDOM MULTIPATH MEDIUM

D. T. Magango 2 Oct. 1967 34 p refs

(Contract N00014-66-C-0005)

(TR-24; AD-674525) CFSTI: HC $3.00/MF $0.65

Three filtering techniques that can be employed in the recovery of a signal after it has propagated through a nonrandom, distortionless, multipath channel have been studied. The generalization of these studies to the random medium situation is the purpose of this report. A fixed, omnidirectional source emits a signal which propagates through a multipath medium and is detected by an array of point receiving elements located at some arbitrary distance from the source. The medium is characterized by a set of attenuation and delay random variables associated with each of the multiple paths. In addition, the additive noise contributed by the medium is assumed to be negligible. The detected signals are then processed by delay filtering, matched filtering, or frequency-inverse filtering. The criterion for comparison of these three filtering schemes is the ratio of the standard deviation of the filtering schemes output time-average power to the expected value of this power. It is found that under certain constraints this ratio is approximately independent of the delay statistics of the medium, and the duration and frequency of the input for the three filtering schemes. In addition, this ratio is approximately equal for delay and matched filtering and is square root of 2 times greater for frequency-inverse filtering. Author (TAB)

N68-38145# IIT Industrial Labs., Fort Wayne, Ind.

BRIGHT RADAR INDICATOR TOWER EQUIPMENT (BRITE-1) Final Report

Nelson Hoag and Ike Studebaker May 1968 40 p refs

(Contract FA-67-WA-1695)

(FAA-RD-68-28; AD-674439) CFSTI: HC $3.00/MF $0.65

The purpose of the report is to document the significant design and development factors determined during the prototype phase. In addition, the mode of PPI to TV conversion (i.e. CRT to Vidicon through optical coupling) along with all basic system parameters is defined in the engineering requirement ER-D-130-013 dated January 19, 1966. Therefore, the discussions are limited to those areas where problems occurred or where specific development was pursued to achieve optimum design. Author (TAB)

N68-38155*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

STUDY, OPTIMALIZATION, AND COMPARISONS OF THE ACQUISITION CHARACTERISTICS OF PHASE-LOCKED LOOP SYSTEMS [ETUDE, OPTIMALISATION ET COMPARAISONS DES CARACTERISTIQUES D'ACQUISITION DE SYSTEMS BOUCLES A BLOCAGE DE PHASE]

Daniel Ludwig Washington NASA Oct. 1968 170 p refs Transl. into ENGLISH from a French thesis

(Contract NASw-1692)

(NASA-TT-F-11689) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The phenomenon of acquisition in a phase-locked loop receiver is demonstrated in a receiver with a multilinear detector which is intended for high performance. Since the essential point is

considered to be a decrease of the acquisition time, the normal operation of the system is modified by adding to the input of the local oscillator an auxiliary signal whose optimum shape is determined with the model of the Pontryagin maximum principle. The signal is shown to be a simple square wave, regardless of the type of phase detector considered. The initial examination concerns a receiver with a multilinear phase detector and zero damping factor. The study of the effect due to the amplitude of the auxiliary signal permits consideration of two modes of operation. A large number of curves permit comparison of the performances of the optimalized systems according to detectors, proposed mode of operation, and circuit parameters (especially the damping factor). The superiority of the receiver with a multilinear detector over the reciever with a sine-wave detector is demonstrated clearly. Author

N68-38161*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AIRBORNE INSTRUMENTATION AND DATA TRANSMISSION RESEARCH AT MSFC. RESEARCH ACHIEVEMENTS REVIEW, VOLUME 3

1968 57 p refs

(NASA-TM-X-53760; Rept.-1) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Investigations are reported on optical filters, galactic X-ray source identification, AM baseband telemetry techniques, and redundance removal techniques. The operation and characteristics of narrow band Fabry-Perot filters for solar observations are discussed. The filters are designed to study a 0.5 and 1.0 Å wavelength range at the H-α line, and are to be used on the ATM telescopes for locating and monitoring solar disturbances. The design and operation of the orbiting X-ray sensor are described. The sensor is an approved AAP experiment, and is expected to map all low flux X-ray sources on the celestial sphere. The telemetry system for wideband data transmission incorporates frequency division multiplexing to modulate a conventional FM telemetry transmitter. It was determined that carrier synthesis and reconstruction techniques can provide the necessary degree of phase coherence. Results of analytical and empirical studies of redundancy removal techniques for telemetry data compression are described. N.E.N.

N68-38162# Environmental Science Services Administration, Boulder, Colo. Space Disturbances Lab.

PRELIMINARY TEST RESULTS OF A TIME DISSEMINATION SYSTEM USING THE VHF TRANSPONDER ON THE ATS 1 SATELLITE

R. N. Grubb and S. D. Gerrish Mar. 1968 38 p refs

(ERLTM-SDL-9; AD-674551)

Some preliminary test results are given of a time dissemination experiment using simple ground equipment communicating through ATS 1 satellite VHF transponder. It is demonstrated that an operational system with an accuracy of the order of 10 microseconds should be realizable. Author (TAB)

N68-38179# Michigan Univ., Ann Arbor. Cooley Electronics Lab.

INTERSYMBOL INTERFERENCE IN BINARY COMMUNICATION SYSTEMS

Christopher V. Kimball Aug. 1968 213 p refs

(Contract Nonr-1224(36))

(Rept.-3674-18-T; TR-195; AD-674423) CFSTI: HC $3.00/MF $0.65

When a binary communication system transmits symbols through a bandlimited channel, the received symbols will generally overlap in time, giving rise to intersymbol interference. In the presence of noise, intersymbol interference produces a significant increase in the system probability of error. The problem of intersymbol interference and noise is considered here for known, linear, time invariant channels and with added white Gaussian noise. Although a particular underwater acoustic channel is used as a source of motivation, the results presented are equally applicable to other communication channels. Traditional approaches to the intersymbol interference problem--spectrum and transversal (time) equalization are examined. A basis for the comparison of intersymbol interference problems using the concept of phase equalization, is given. A major assumption which limits the interference to that caused by adjacent symbols is made. This assumption is shown to be equivalent to restricting the transmitter to reasonable signalling rates relative to the bandwidth of the channel power spectrum. All subsequent analysis and evaluation are done under this assumption. Several linear filter receivers prevalent in the literature are reviewed and evaluated. Two easily implemented nonlinear receivers are considered as alternatives to the more complex optimized linear filter receivers. The iterated switched-mode receiver is shown to perform better than any optimized linear receiver when intersymbol interference is moderate. Author (TAB)

N68-38217# Joint Publications Research Service, Washington, D. C.

RADAR POLARIZATION EFFECTS

D. B. Kanareykin et al 9 Oct. 1968 45 p refs Transl. into ENGLISH from the book "Polarizatsiya Radiolokatsionnykh Signalov" Moscow, Soviet Radio Publishing House, 1966 p 298-314, 380-406

(JPRS-46624) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. STATISTICAL PROPERTIES OF PARTIALLY POLARIZED SIGNALS AND NOISE IN RADAR RECEIVING CHANNELS WITH A SPATIALLY ORTHOGONAL POLARIZATION ANALYZER p 1-15 refs (See N68-38218 24-07)

2. POLARIZATION CHARACTERISTICS OF CERTAIN RADAR TARGETS p 16-40 refs (See N68-38219 24-07)

N68-38218# Joint Publications Research Service, Washington, D. C.

STATISTICAL PROPERTIES OF PARTIALLY POLARIZED SIGNALS AND NOISE IN RADAR RECEIVING CHANNELS WITH A SPATIALLY ORTHOGONAL POLARIZATION ANALYZER

In its Radar Polarization Effects 9 Oct. 1968 p 1-15 refs (See N68-38217 24-07)

The properties are discussed for two-channel radar equipment which gives complete reception of the signal and has an antenna system offering the possibility of obtaining any polarization of the illuminating wave. Expressions are developed to describe the effect of the internal noise of the radar receiving channels on a fluctuating target signal. A discussion is presented of the statistical properties of fluctuating target signal and noise in radar amplitude channels and in the phase meter. Relations are obtained for estimating the fluctuations of the amplitude and phase difference envelopes of the orthogonal components of the signal resulting from receiver noise. Author

N68-38219# Joint Publications Research Service, Washington, D. C.

POLARIZATION CHARACTERISTICS OF CERTAIN RADAR TARGETS

In its Radar polarization effects 9 Oct. 1968 p 16-40 refs (See N68-38217 24-07)

Previously published experimental results with various types of targets are generalized. Symmetrical point targets are considered to be among the simplest targets, and the polarization characteristics are discussed for spheres, right-angle reflectors, and convex oval

shapes. Ground cover targets are divided into two types: those which give mirror reflections such as still water, landing strips, and highways, and those which give diffuse reflections such as grass, shrubs, and forests. The shapes and reflecting properties of atmospheric particles-rain drops, cloud droplets, and ice particles-are also discussed, and the application to meteorology is indicated. N.E.N.

N68-38220# Stanford Univ., Calif. Dept. of Statistics.
REMARKS ON HIGHER-ORDER SPECTRAL RELATIONSHIPS IN A LINEAR TIME SERIES MODEL
Paul Shaman Aug. 1968 28 p refs
(Grant DA-ARO(D)-31-124-G726)
(TR-24; AD-674263) CFSTI: HC $3.00/MF $0.65

The report describes the application of higher-order spectra to linear systems where a non-Gaussian input is measured without noise contamination, so that use of higher-order spectral analysis is not necessary to obtain an expression for the transfer function, which is simply the ratio of the cross spectrum between the input and the output to the spectrum of the input. However, because the input is non-Gaussian it is meaningful to consider use of higher-order spectra in connection with study of the system. We shall obtain relationships among various higher-order cross spectra. Mixed spectra will also be applied to the problem. TAB

N68-38224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMMAND RADIO LINKS OF ROCKET CONTROL SYSTEMS
A. M. Zhakov et al Dec. 1967 35 p refs Transl. from the book Upravlenie Ballisticheskimi Raketami (Moscow), 1965 p 211-240, 275-278
(FTD-MT-24-352-67; AD-674679)

This is chapter VI from a book intended for officers of the Soviet Armed forces in the fields of engineering and technology and for rocketry students. It deals with electronic systems, velocity and position measurements and command transmissions from control centers. TAB

N68-38227# Boeing Co., Renton, Wash. Airplane Div.
COUPLING BETWEEN ANTIPODAL VHF-UHF ANTENNAS ON LARGE JET AIRCRAFT
Luis L. Uh 6 Aug. 1968 64 p refs
(D6-23291; AD-673935) CFSTI: HC $3.00/MF $0.65

Experimental and theoretical studies were conducted to determine the signal isolation top- and bottom-mounted VHF-UHF antennas on jet aircraft. A 1/4 scale conducting cylinder was used to simulate a Boeing 707 fuselage. Effects of the wings and other protuberances were neglected. Both blade and slot antennas were investigated. The natural phase relations which exist between electromagnetic waves diffracted around the aircraft fuselage were exploited to achieve isolations of 60-80 db between antennas mounted antipodally. Author (TAB)

N68-38232# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
THE TIME DOMAIN BACKSCATTER FROM DIPOLE ANTENNAS ILLUMINATED AT BROADSIDE
Randolph H. Ott 8 Jul. 1968 35 p refs
(AFCRL-68-0308; B-2; AD-674068) CFSTI: HC $3.00/MF $0.65

The time domain scattering for an isolated dipole and then for uncoupled dipoles are investigated theoretically. The basic approach used is the Fourier transform of the frequency-dependent scattering function. The following information may be obtained from an investigation of the output waveform: (1) the approximate length of the scatterer (from the resonant frequency of the scattered waveform), (2) a qualitative indication of the Q of the scatterer (from the envelope of the output waveform), and (3) the relative separation of n scatterers. Author (TAB)

N68-38284# Naval Avionics Facility, Indianapolis, Ind.
MICROWAVE ASSEMBLY FOR THE HELCAR 3 RADAR SET Final Engineering Report
Frank E. Hassold, Jr. 7 Aug. 1967 37 p
(NAFI-TR-1081; AD-674859) CFSTI: HC $3.00/MF $0.65

The microwave assembly was designed and developed for the HELCAR III Radar, which is a pulsed system operating between the frequencies of 9.6 and 10.0 GHz. This system was designed for use in helicopters to aid in collision avoidance, station keeping, navigation, and ASW tactical operations. Author (TAB)

N68-38316# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERFERENCE CONTROL
A. A. Kharevich Jan. 1968 232 p refs Transl. into ENGLISH of the book "Bor'ba Pomekhami" Moscow, Izd. Nauka, 1965 p 1-222
(FTD-MT-24-251-67; AD-674311)

The problem of reliable transmission of signals when there is interference is one of the most important problems of applied information theory at the present time. This monograph is a brief introduction to the modern theory of the methods of increasing interference resistance. It contains a compact presentation of the newest methods, views, and results permitting the problem to be viewed as a whole. The books objective is to help the beginner working in this field to derive a general picture of the problem and to obtain the basic information that is needed for a study of the special literature. The book is intended for radio physicists and radio engineers. TAB

N68-38326# Joint Publications Research Service, Washington, D. C.
SATELLITE TRACKING STATION DESCRIBED
Mitko Gogoshev *In its* Transl. on Eastern Europe Sci. Affairs 10 Oct. 1968 p 1-6 Transl. into ENGLISH from Byull. na Astron. Observ. v Stara Zagora (Bulgaria), no. 1, 1968 p 13-18 (See N68-38325 24-34)

Test facilities, optical measuring equipment, tracking pavilions, educational and training programs, and data analysis techniques used at the second Bulgarian artificial satellite tracking station (i.e., 1102) of the new astronomical observatory are briefly discussed. The satellite tracking station participates in the following international scientific programs: (1) the ephemeris service of the Soviet Academy of Sciences; (2) the Interobs program which focuses on the determination of atmospheric density and its variations; and (3) the SPIN program which has as its objective the determination of the axial rotation of artificial earth satellites. S.C.W.

N68-38330# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
OPTIMUM BINARY INTEGRATION
R. A. Worley 26 Mar. 1968 34 p refs
(NELC-1550; AD-672015) CFSTI: HC $3.00/MF $0.65

Some graphical results are presented as aids in selecting optimum thresholds for testing procedure known under the names binary integration, coincidence detection, binomial fixed-sample-size testing, double-threshold detection, K out of N detection, etc. Optimum thresholds are given for the Normal (test of the mean and test of the variance), Rayleigh, Swerling Case 4, and Rice

distributions. For the latter three distributions, curves of the required signal-to-noise ratio versus the number of pulses and of the miss probability versus the signal-to-noise ratio are given. All of the results assume statistically independent observations. Author (TAB)

N68-38426# Army Test and Evaluation Command, White Sands Missile Range, N. Mex. Deputy for National Range Operations.
A TUTORIAL DERIVATION OF RECURSIVE WEIGHTED LEAST SQUARES STATE-VECTOR ESTIMATION THEORY (KALMAN THEORY)
James S. Pappas Aug. 1968 69 p refs
(RO-S-68-2; AD-674406) CFSTI: HC $3.00/MF $0.65

This is one of a series of tutorial reports deriving the discrete recursive Kalman estimation equations. The series proceeds from unweighted to weighted least squares parameter estimation in a vector space setting to the stage-wise updating, to time varying parameter or state variable estimation. The derivatives have been stage-wise tutorial in an attempt to make the theory accessible to the non-specialist in optimization theory. Author (TAB)

N68-38471# Stanford Research Inst., Menlo Park, Calif.
FULL SCALE PATTERN MEASUREMENTS OF SIMPLE HF FIELD ANTENNAS IN A TROPICAL FOREST IN THAILAND Special Technical Report 35
Gary E. Barker and Glenn D. Koehrsen Feb. 1968 421 p refs
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-674739) CFSTI: HC $3.00/MF $0.65

During June and July 1966, measurements of the radiation patterns and impedances of selected HF field-expedient antennas were made in a tropical forest in Thailand on frequencies in the range 2 to 15 Mc/s. These tests completed a sequence of measurements on the same and similar antennas (including dipoles, inverted Ls, slant wires, and monopoles) in an open, level field, in a U.S. conifer forest, and in a dry-evergreen forest in Southeast Asia. The pattern measurements were made by towing a small, battery-powered transmitter driving a short Hertzian dipole on a long dielectric cable behind an aircraft whose position was electronically tracked. The results are presented as contour maps showing the response for orthogonal polarizations (vertical, E sub theta and horizontal, E sub phi) as functions of azimuth and elevation for the elevation range from about 5 degrees to about 55 degrees from the horizon. The power response (normalized Poynting vector) is presented in the same format for the elevation range from 5 degrees to the zenith. Relative gain values are presented for the maximum observed response of the various antennas on a given frequency and for the polarization response E sub theta/E sub phi for a given antenna and frequency. The data indicate that vertical polarization is attenuated more than horizontal polarization, and that scattering of the vertically polarized signal begins at about 12 Mc/s. Impedance data are presented on Smith charts for each antenna over the range of frequencies for which pattern data were obtained. They show that the environment tends to become part of the antenna. Author (TAB)

N68-38475# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
RADAR CLUTTER RESEARCH Final Report
Stephen N. Andre, Marley E. Bechtel, and David A. Foster Jul. 1968 181 p refs
(Contract DAAH01-67-C-2516)
(CAL-UB-2508-E-1; RE-TR-68-11; AD-673938) CFSTI: HC $3.00/MF $0.65

The objective of this program was to prepare a clutter research plan for Army Air Defense Weapons that encompasses the anticipated methods of employment of these weapons, as well as the problems associated with the introduction of new radar technology in these systems. Specifically, the investigations included studies of the physics of electromagnetic scattering from rough surfaces, a definition of clutter problems as related to innovations in radar technology such as electronic beam steering, signal processing and design, computer technology, study of clutter models and simulation techniques, and a study of clutter effects in a radar defense complex. Probability density functions, correlation functions and Doppler spectra of clutter signals are derived for the configuration in which only a few major scatters are present. Results are presented for both coherent and noncoherent detection. Methods of simulating clutter, using both analog and digital approaches are described. Emphasis is placed on advanced forms of simulators such as would be required for evaluation of future multidimensional radar systems rather than on additive filtered noise for the simulation of clutter. The simulation techniques are based on two suggested generic forms of clutter models, called open-loop and closed loop. Because of the greater flexibility of closed-loop simulation, this is presented in greater detail. Techniques for performing radar clutter measurements are described and some of the significant problems, related primarily to terrain and cultural observables, are discussed. Clutter problems as related to their systems and innovations in radar technology, such as electronically steered phase arrays, are also described. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-37469# Oak Ridge National Lab., Tenn. Neutron Physics Div.
MODIFICATIONS OF THE POINT-KERNEL CODE QAD-P5A: CONVERSION TO THE IBM-360 COMPUTER AND INCORPORATION OF ADDITIONAL GEOMETRY ROUTINES
E. Solomito and J. Stockton Jan. 1968 243 p 17 refs
(Contract W-7405-ENG-26)
(ORNL-4181) CFSTI: HC $3.00/MF $0.65

The point-kernel code QAD-P5A, used for both neutron and gamma-ray shield penetration calculations, has been converted to FORTRAN 4 language for use on the IBM 360/75 computer. The code has also been modified to use the generalized geometry subroutines of the 05R code, as well as special 05R subroutines for cylindrical class of spherical geometries. With the increased speed of the IBM-360 computer and the ability of the generalized geometry to describe arbitrary shapes, the versatility of the code has been increased. Another modification has been the addition of a lithium hydride kernel for use in neutron calculations; the kernel was obtained from moments method calculations. Author (NSA)

N68-37484 Texas Univ., Austin.
AN ANALOG COMPUTER FOR THE OPERATION OF DIVISION
Robert Bruce Johnston (Ph.D. Thesis) 1966 168 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 67-14906

This dissertation is concerned with the operation of division as accomplished by electronic analog computers. The device accomplishes division by use of a summing amplifier, a multiplier and appropriate feedback loops. The stability and other problems inherent in a high gain feedback divider are avoided; low over all gain and positive as well as negative feedback loops are used to produce a very stable divider. A four quadrant quarter-square

multiplier was used. The operations of adding, subtracting, inverting and multiplying by a constant were performed using precision resistors suitably arranged in the input and feedback networks of high gain, chopper stabilized, D.C. amplifiers. Dissert. Abstr.

N68-37506# Oak Ridge National Lab., Tenn.
LINEAR: A COMPUTER PROGRAM TO FIT DATA EASILY TO MANY MODELS BY THE WEIGHTED LINEAR LEAST-SQUARES METHOD
E. Schonfeld Jul. 1968 24 p 3 refs
(Contract W-7405-eng-26)
(ORNL-4264) CFSTI: HC $3.00/MF $0.65

LINEAR is a computer program, written in FORTRAN, that fits experimental data easily and rapidly to as many as 80 different models by the weighted linear least-squares method. The program permits the user to introduce his own model. Execution time on the CDC-1604 is about 1 min, and the cost is about $1.00 to $2.00. The program is written in such a way that it can be used with different computers and computer languages, such as FORTRAN 2 (IBM-7090), FORTRAN 62 (CDC-1604, -3600), FORTRAN 63 (CDC-1604, -3600), FORTRAN 360-ORNL (IBM-360), FORTRAN 4 (IBM-7094/0), FORTRAN 4 (IBM-360), FORTRAN 4 (UNIVAC-1108), and FORTRAN ASA. Author (NSA)

N68-37582*# System Development Corp., Santa Monica, Calif.
AN ON-LINE SYSTEM FOR UTILIZING HAND-PRINTED INPUT Progress Report
M. I. Bernstein 18 Dec. 1967 53 p
(Contracts NAS12-526; F19628-67-C-0004)
(NASA-CR-86108; TM(L)-3052/001/00) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Review of the progress made through September 1967 on developing a program to recognize hand printed characters on line in real time. The program operates under the SDC time sharing system on the Q-32 computer. Details on all of the important facets of the program, primarily in the form of flow charts, and glossary of terms and notation used are included. Author

N68-37691# Naval Weapons Lab., Dahlgren, Va.
SUBROUTINES TO FACILITATE VISUAL DISPLAY AND MAN-MACHINE RELATIONSHIPS USING THE STANDARD OPERATING SYSTEM ON AN IBM 360 COMPUTER
David F. Eliezer and Richard L. Fausey Jul. 1968 236 p refs
(NWL-TR-2155; AD-672020)

A group of subroutines is described which facilitates the utilization of the buffered IBM 2250 display terminal associated with an IBM system/360. The routines provide a means of displaying graphs and textual material and provide for efficient use of the light pen and other associated devices. Author (TAB)

N68-37744 Maryland Univ., College Park.
THE THROUGHPUT AND COST EFFECTIVENESS OF MONOPROGRAMMED, MULTIPROGRAMMED, AND MULTIPROCESSING DIGITAL COMPUTERS
Bruce Wald (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-3394

A generalized model of a digital computer system with a workload drawn from a proffered infinite workload was investigated to determine the factors that affect throughput and cost effectiveness to allow optimization of the system parameters. Throughput was defined as the sum of the products of the cost of each component and the proportion of the time each component was beneficially used. Cost effectiveness was defined as the quotient of throughput and system cost, with unity being the ideal quotient. Each of the jobs constituting the workload consisted of a fixed number of segments, each alternately requiring processing and output. The memory requirements of a segment consisted of a fixed component required at all times, another fixed component required only during processing, and a third component required at all times. This third component was usually assumed to be exponentially distributed, and output time was assumed proportional to this component. Dissert. Abstr.

N68-37814# Atomic Energy Commission, Washington, D. C.
USE OF SMALL COMPUTERS FOR EVALUATION OF GAMMA BORE LOGS
Lothar Hartmann et al 28 Jun. 1968 15 p 3 refs Transl. into ENGLISH from Z. Angew. Geol. (Berlin), v. 13, no. 4, 1967 p 212–217
(AEC-TR-6942) CFSTI: HC $3.00/MF $0.65

A new method is described for evaluating gamma well logs recorded point-by-point, using the small automatic computer "Cellatron" SER 2b. This method is based on a theory developed by R. Roesler. Contrary to other methods it is operated on a purely numerical basis which makes it possible to use small computers. The principle and advantages of the method are discussed. Author (NSA)

N68-37816# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE MULTITERMINAL COMPUTER [O MNOGOPULTOVOI VYCHISLITELNOI MASHINE]
M. V. Mishurnaya Sep. 1967 10 p Transl. into ENGLISH from Vychislitelnaya Tekhn. (Minsk), 1965 p 10–14
(FTD-MT-24-236-67; AD-674687)

A computer time-sharing/Minsk-2 computer system based on multiple input-output terminals is described. The author proposes the replacement of electro-mechanical or manual desktop calculators by remote user terminals, which would permit routine processing of numerical data, e.g., during the preparation of computer programs. Two methods are proposed which in essence amount to on-line and of-line data-processing. The first method consists of preparing a punched tape on the remote terminal and then using this tape as an input to the computer; the second method, described in more detail involves the use of teletypewriters linked through suitable buffers to the input terminal of the computer. As an example a multi-terminal system, the Minsk-2 computer equipped with several remote I/O terminals is described and its efficiency in calculating a number of simple mathematical functions is compared to the electro-mechanical calculators. For example, the calculation of any trigonometric function (including data entry and answer print-out) requires only 5-6 seconds, whereas simple multiplication requires 4-5 seconds on a desktop calculator. The economic advantages of multiterminal computer operation will no doubt make its use widespread in the future. TAB

N68-37977# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENT IN APPLICATION OF METHODS OF PROGRAMMED INSTRUCTION [OPYT PRIMENENIYA METODOV PROGRAMMIROVANNOGO OBUCHENIYA]
S. L. Fradkin 21 Dec. 1967 14 p Transl. into ENGLISH from Srednee Spets. Obrazov. (USSR), no. 8, 1966 p 39–44
(FTD-MT-24-363-67; AD-674706) CFSTI: HC $3.00/MF $0.65

An analysis is made of various forms and methods of programmed learning. The primary developments in the introduction of programmed learning methods are: creation of programmed teaching aids; use of existing textbooks for programmed learning; conducting programmed lectures with feedback; and use of both

teaching machines and machineless methods of checking knowledge. These directions are described in some detail and compared. It is noted that the potential of programmed learning for saving the students time is often not realized, due to the fact that the students are not accustomed to the increased amounts of independent work which programmed learning requires. Some examples of programmed methods used in the authors school are presented. Subjects taught are primarily technical. TAB

N68-37979# Morrissey (John) Associates, Inc., New York.
COMPUTER PROGRAMS: INTERNAL REPRESENTATION Final Report, 15 May 1967–15 May 1968
R. Barbieri and J. Morrissey 5 May 1968 88 p refs
(Contract F19628-67-C-0303)
(AFCRL-68-0319; AD-674617)

This report describes an internal representation of the FORTRAN executable statements in the 1130 computer. An interpreter is designed for execution of the statements in a time-sharing system. The effect of the internal form on the algorithm for execution of each statement is discussed. Problems, due to language features, core size, or the time sharing environment, are presented and solutions are proposed giving consideration to the tradeoff that can be made between space and time. Author (TAB)

N68-38018# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPLETE-MODULO EQUIPMENT CHECK IN A SYSTEM OF TWO IDENTICAL COMPUTERS [APPARTNYI KONTROL PO POLNOMU MODULYU V SYSTEME IZ DVUKH ODNOTIPNYKH EUM]
Yu. I. Torgov et al 30 Nov. 1967 13 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Vychislitel'nyy Tsentr. Tr. Kontrol Raboty Elektronnykh Vychislitel'nykh Mashin (USSR), 1965 p 24–31
(FTD-MT-24-353-67; AD-674704) CFSTI: HC $3.00/MF $0.65

One high-reliability control method is that of simultaneous solution of a problem by two machines, where checking can be performed by simply comparing the results in as fine a detail as necessary, down to operation-by-operation, of the two machines in case of disagreement. A block diagram is presented of an automatic comparator used in conjunction with two identical computers working synchronously on the same problem. The advantages of the method are stated to be: reduction in personnel needed for operation of equipment; reduction in the mathematical expectation and dispersion of repair time; redundancy of equipment for real-time problem solution; simplicity of synchronous control and circuitry required. TAB

N68-38026# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME PROBLEMS IN GENERATING NUMERICAL INFORMATION FOR VISUAL OBSERVATION [NEKOTORYE VOPROSY FORMIROVANIYA TSIFROVOI INFORMATSII DLYA VIZUALNOGO NABLYUDENIYA]
V. F. Yurev et al 8 Dec. 1967 9 p Transl. into ENGLISH from Akad. Nauk Belorussk. Inst. Tekh. Kibernetiki. Vychislitel'naya Tekh. Nauka i Tekh., Minsk, 1965 p 163–167
(FTD-MT-24-343-67; AD-674690) CFSTI: HC $3.00/MF $0.65

Alphanumeric characters can be formed on electroluminescent display panels consisting of individually controlled elements. Separate logic modules are used for each character to be generated, such that no information concerning the structure of the characters need be stored. The output of the character-generating modules is channeled to the appropriate position on the display panel. Each display module consists of 40 elements, arranged in 5 rows and 8 columns. The individual elements are actuated by applying voltages of opposite polarities to the corresponding x and y terminals. The display unit consists of three modules: the electroluminescent panel, the driver unit, and the character generating logic module. A single pulse from the computer control logic module initiates the formation of a character by opening a gate and admitting clock pulses into the character generating logic module. The clock pulses are used to actuate each row driver from 1 to 8 in succession. The corresponding column drivers are either actuated or inhibited by the outputs from the character generating logic module. Thus a number or a letter is formed by the luminescing elements at the intersections of actuated columns and the sequentially energized rows. TAB

N68-38060# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CENTRALIZED SYSTEM FOR ASSEMBLY AND PROCESSING OF INFORMATION (SOFI) [TSENTRALIZOVANNAYA SISTEMS SBORA I OBRABOTKI INFORMATSII (SOFI)]
M. N. Ivanov et al 1 Jan. 1968 27 p refs Transl. into ENGLISH from Tr. Nauchn. Tekhn. Konf. Po Yadernoi Radioelektronie 6th Analizatory, Bloli Nakoplenie i Obrabotka Inform. (USSR), 1965 p 110–136
(FTD-MT-24-350-67; AD-674703) CFSTI: HC $3.00/MF $0.65

The operational principle and basic equipment of a centralized system for the assembly and processing of information are described in detail. The system consists of a memory core device, a control device, several input arrangements, an output arrangement and extension testing panels. The technical characteristics of the system are as follows: 2048 channels; channel volume, 2 to the 16th power; there are 8 input devices; interrogation period, 5 micro sec; registration time of the number, 82 micro sec; maximum registration frequency, 12,000 pulses/sec; data output speed with digital printout, 20 lines per sec; and the output speed on the perforator, 20 octal signs per second. The possibility of multi-dimensional measurements is foreseen. The design is of block type, with easily interchangeable parts. Logic elements are made with semiconductor devices. TAB

N68-38084# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
THE USE OF MULTIPLE ASSOCIATIVE MEMORIES IN PROGRAMMING THE GROWING MACHINE Interim Technical Report
Robert Paul Bair May 1968 160 p
(Contract DA-31-124-ARO(D)-98; NSF GP-5661)
(AROD-4166-15-m; AD-674199)

The Growing Machine is a model of a processor with a recursively expandable instruction set, employing an associative memory (a function from name to definition) so that instructions and data, which are both stored as list structures, can be referenced symbolically. The software implementation of the Growing Machine called GAIN is described. This version gives the user the ability to easily manipulate the associative memory, create multiple associative memories and interchange them, and create a pushdown of associative memories. Optionally, a name may be bound at its occurrence to a particular definition, making it independent of the associative memory. The technique for, and the programming advantage of, dynamically changing the associative memory function in these ways during execution is examined. It is shown that the Growing Associative Interpreter is universal in the sense that it can simulate any other interpreter in its single cycle. Author (TAB)

N68-38117# Oregon State Univ., Corvallis. Computer Center.
THE LOGICAL DESIGN OF THE NEBULA COMPUTER

John A. Boles (Ph.D. Thesis) Jun. 1968 158 p refs
(Contract NONR-1286(11))
(CC-68-23; AD-673990)

Oregon State University has designed and constructed a serial digital computer using glass delay lines circulating at 22 MHz, as memory. The design objectives as originally conceived were: (1) To be a research project in computer design. (2) To be used as an educational machine. (3) To have easily modifiable hardware for basic research in computer design. This report describes the system design and logical design in detail. Author (TAB)

N68-38211# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERAL-PURPOSE COMPUTER SYSTEMS WITH PARTIALLY VARIABLE STRUCTURE [UNIVERSALNYE VYCHISLITELNYE SISTEMY S CHASTICHNO PEREMENNOI STRUKTUROI]

E. V. Evreinov Jan. 1968 68 p refs Transl. into ENGLISH from Vychislitel'nnye Sistemy (USSR), no. 17, 1965 p 3–60
(FTD-MT-24-362-67; AD-674219) CFSTI: HC $3.00/MF $0.65

The general-purpose computer with a partially variable structure is defined as an s-terminal network with one elementary machine (EM) at each of its nodes. The input and output terminals of each EM are identified with the output and input terminals of adjacent elementary machines correspondingly. In addition, a certain subset of the input and output terminals is set aside for the whole general purpose computer system. The EM consists of a finite automation K with inputs and outputs and a general purpose V. M. Glushkov programming automation capable of realizing the operations such as transmission and reception of information, generalized conditional transfer, and adjustment. It is proved that any finite automation may be realized with this general-purpose computer system which is universal in V. M. Glushkovs sense and capable of performing any parallel algorithm. The problems associated with the speed of response, reliability, and cost of construction of this general-purpose computer system are examined. TAB

N68-38213# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE SYNTHESIS OF MICROPROGRAMMING AUTOMATS [O SINTEZE MIKROPROGRAMMYKH AVTOMATOV]

V. G. Lazarev 29 Sep. 1967 29 p refs Transl. into ENGLISH from Probl. Peredachi Inform (USSR), v. 1, no. 2, 1965 p 83–78
(FTD-HT-23-834-67; AD-674217) CFSTI: HC $3.00/MF $0.65

The concept of the 2nd-order microprogram automation (MA) is defined and a class of such automatons is determined, which includes such various forms of autonomous automatons as a central (programmed) control unit for a wide variety of control apparatus for information distribution systems, digital computer microprogram control units, etc. An autonomous MA (i.e., an automaton which can have only one input state R) is analyzed, with its working conditions described through the use of allogical algorithmic language are defined, and its shown how an algorithm for the abstract synthesis of an autonomous MA may be formulated on the basis of this language. State transition tables are analyzed for various versions of logical algorithm languages in order to illustrate the simplification of the language (i.e., the realization of an automaton with the least number of internal states) which is a necessary prior condition to the transition to a standard language defining the automaton. A matrix method, based on the compression of the automaton state matrix, is proposed, whereby it is possible to combine identical operators present in the different algorithmic languages. TAB

N68-38223# Wisconsin Univ., Madison. Mathematics Research Center.

COMPUTER PROGRAMMING FOR ACCURACY

J. M. Yohe Apr. 1968 27 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-866; AD-674459) CFSTI: HC $3.00/MF $0.65

In most computations, it is tacitly assumed that the results produced by the program are accurate enough. This assumption is not always valid. In this report, we discuss several possible sources of error in digital computation, and we list several steps which can be taken to guard against some types of error and determine an upper bound for the effects of other types. We illustrate these techniques with our experience in writing a program to locate zeros of the Riemann zeta function. Author (TAB)

N68-38303# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DIGITAL COMPUTER OF GEOMETRIC CHARACTERISTICS OF SECTIONS RELATIVE TO CENTRAL AXES [TSIFROVOI VYCHISLITEL GEOMETRICHESKIKH KHARTERISTIK SECHNII OTNOSITELNO TSENTRALNYKH OSEI]

V. P. Kolomiets 6 Oct. 1967 12 p refs Transl. into ENGLISH from Samoletostroyeniye i Tekh. Vozdushnogo Flota, no. 4, 1965 p 91–97
(FTD-HT-23-850-67; AD-673950) CFSTI: HC $3.00/MF $0.65

The report considers a specialized device for automatically determining the position of the center of gravity and the moments of inertia in a cross section with respect to central axes for structural strength calculations. The advantages of specialized machines over general-purpose computers are discussed, particularly from the economic standpoint. It is pointed out that the latest achievements in the development of reliable and highly accurate photoelectric systems for line tracing as well as systems for programming an outline to a given scale have made it possible to automate the process of calculating geometric characteristics without using a digital computer. The TsGI-2 instrument described by the author computes the position of the center of gravity and the moments of inertia of a given cross section in two stages. In the first stage the instrument operates as an integrator for calculating the area, static moments and moments of inertia for the given cross section in a rectangular coordinate system according to simplified formulas. In the second stage, the calculator is set up to solve algebraic equations using the solutions from the first stage to find the position of the center of gravity and moments of inertia of the cross section with respect to central axes parallel to the axes of the given coordinate system. Author (TAB)

N68-38319# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BINARY-DECIMAL REVERSIBLE COUNTER [DVOICHNO-DESYATICHNYI REVERSIVNYI SCHETCHIK]

I. N. Gorelikov et al 9 Nov. 1967 7 p Transl. into ENGLISH from Soviet Patent No. 174008 (Appl. No. 918010/26-10, 24 Aug. 1964) 2 p
(FTD-HT-23-951-67; AD-674315) CFSTI: HC $3.00/MF $0.65

This Author Certificate introduces a binary-decimal reversible counter for digital measuring instruments. It is designed for 4-2-2-1 codes and contains four static flip-flops connected at the counting inputs. It features a logical potential AND circuit which fixes the coincidence of the 1 states in the two higher order digits of the counter. The output of the AND circuit is connected to the flip-flop representing the 2 states. In the absence of a potential at the output of the logical circuit, this trigger acts as a monostable multivibrator. TAB

N68-38334# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALOG-DIGITAL COMPUTER USING MAGNETOSTRICTIVE DELAY LINES [TSIFRO-ANALOGOVOE VYCHISLITELNOE USTROISTVO NA MAGNITOSTRIKTSIONNYKH LINIYAKH ZADERZHKI]
M. M. Sukhomlinov, N. K. Ferenets, E. L. Onishchenko, N. I. Lelipenko, and V. S. S. Shikalov 18 Oct. 1967 16 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Avtomat. i Telemekhaniki (Tekhn. Kibernetiki), Vychislitel'naya Tekhn. v Upr., 1966 p 143–152
(FTD-MT-24-289-67; AD-674691) CFSTI: HC $3.00/MF $0.65

The authors describe the design and performance of a digital differential analyzer using magnetostrictive delay lines as memory elements. The authors claim that such a memory has the advantages of a high speed ferrite core memory and the economy of a magnetic drum. The digital differential analyzer has the following parameters: 32 integrators, binary operational code, 20 bit words, 250 KHz cycle rate, 400 operations per second, and error not exceeding 0.01%. The operational program and the initial conditions are entered manually through switches on a control console. The data entry can be manual, using decimal or binary codes, or automatic. The digital differential analyzer consists of a memory, computational unit, control unit, input and output equipment, control console and code converters. Of particular interest is the design and performance of the memory. The memory uses eight magnetostrictive delay lines. TAB

N68-38425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATISTICAL INVESTIGATIONS OF THE RELIABILITY OF A READING AUTOMAT WITH OPTICAL CORRELATION [STATISTICHESKIE ISSLEDOVANIYA NADEZHNOSTI CHITAYUSHCHEGO AVTOMATA S OPTICHESKOI KORRELYATSIEI]
V. K. Eliseev 7 Dec. 1967 15 p refs Transl. into ENGLISH from Akad. Nauk Ukr. Chitayushchiye Avtomaty i Raspoznavaniye Obrazov (Kiev), 1965 p 113–124
(FTD-HT-23-963-67; AD-674344) CFSTI: HC $3.00/MF $0.65

Experimental evaluation of the reliability of character recognition may become very cumbersome in the case of low-error systems. Hence, an attempt is made to provide a simpler, based on mathematical statistics, method for determining reliability of automatic readers that use the correlation method of recognition. TAB

N68-38462# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTATION TECHNOLOGY IN AUTOMATIC CONTROL SYSTEMS [VYCHISLITELNAYA TEKHNIKA V AVTOMATICHESKIKH SISTEMAKH UPRAVELENIYA]
V. I. Loskutov 29 Sep. 1967 15 p Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Proizv. (Moscow), v. 18, no. 3, 1964 p 44–47
(FTD-HT-23-835-67; AD-674041)

So far the problems of overall automation could, as a rule, be mainly with respect to local processes. The control of large-scale systems representing an intricate complex of interconnected local processes and units, with the human attendant controlling individual facilities and sectors on the basis of analysis and evaluation of the incoming information, still has not been accomplished. Thus, the extraction and correct utilization of information are vital functions of new forms of control. The received information for the formation of control signals is processed in accordance with the appropriate control algorithm and defined by a system of logic rules formalizing the structural properties of the flows of information interchange. At present the following types of automatically controlled information systems exist: control computers for individual industrial and transport facilities; centralized inventory, billing and control systems of industrial enterprises; and large systems for processing information of nationwide significance in planning, supply, finance, statistics, transport, etc. The control computer is an assemblage of devices for the reception and identical transformation of input information in accordance with a given algorithm. TAB

N68-38496# Air Force Academy, Colo.
SPEAL—A RESEARCH REPORT ON A PROBLEM-ORIENTED COMPUTER LANGUAGE FOR ELECTRICAL ENGINEERING ANALYSIS
Harold C. Falk May 1968 76 p ref
(AD-674010)

SPEAL, an acronym for Special Purpose Engineering Analysis Language, is a problem-oriented digital-computer language for circuit analysis. Input data to SPEAL is essentially technical-textbook-English rational-function-of-s network element descriptions in a free-field format and analysis requests in a free-field format. Output from the SPEAL analysis procedures are discussed and illustrated. The network functions procedure provides input impedance, transfer impedance and voltage ratio (gain) functions both in coefficient form and in pole-zero form. A.C. and D.C. analysis procedures provide network voltage, current, power and impedance variables for specified inputs. The frequency response and transient response procedures provide tabular and plotted graphical output of the function as specified. The program is intended for use by electrical engineering students and faculty as an academic and research tool. The language not only permits easy data interpretation, but also permits easy use by the person with no computer experience. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-37433# Dupont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.
DIGITAL SYSTEM FOR FAST PRINTOUT OF ANALYZER MEMORY
J. S. Byrd Jun. 1968 12 p 1 ref
(Contract AT(07-2)-1)
(DP-1154) CFSTI: HC $3.00/MF $0.65

A digital control circuit and code converter was designed to print out the binary data stored in a 4096-channel spectrum analyzer memory. Data and channel identification are printed in decimal form with a high speed digital printer. The entire memory of any multiple of 256-channel subgroups can be printed parallel at the rate of 40 lines per second. Author (NSA)

N68-37457 Michigan Univ., Ann Arbor.
IMPEDANCE CHARACTERISTICS OF PUMPED VARACTORS
David Earl Oliver (Ph.D. Thesis) 1967 272 p
Available from Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 67-17823

The input impedances of several basic pumped varactor diode circuits were analyzed theoretically by determining a suitable model for each circuit and then predicting its impedance characteristics. The results showed good correlation with experimental measurements, indicating the adequacy of the circuit model, and

the validity of the analysis methods. In developing an accurate circuit model, it was shown that several circuit parameters, which had never before been considered important, significantly affect circuit behavior. These parameters include: the exact nature of the diode depletion layer capacity-voltage characteristic; the circuit termination at the pump harmonic frequencies and their sidebands; the minority carrier lifetime of the semiconductor material; and the character of the electric fields in the diode junction. Dissert. Abstr.

N68-37558 Johns Hopkins Univ., Baltimore.
A STATISTICAL APPROACH TO ACCELERATED LIFE TESTING WITH SPECIAL REFERENCE TO ELECTRONIC DEVICES
Joseph Vincent John Ravenis, II (Ph.D. Thesis) 1967 281 p
Available from Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 67-17212

In addition to a detailed description of the concept of accelerated life testing, i.e., a procedure to force electronic device to fail prematurely, a set of actual industrial life test data is presented which is used to test the validity of the technique developed. The mathematical measures and probability density functions that are used to estimate the life characteristics of the electronic devices, as a function of test conditions, are presented. A brief discussion of the graphic methods that can be used to ascertain a rough idea of the distributional form of the data and the method of maximum likelihood is also presented. The maximum likelihood results obtained from the given data are given. Graphic analysis and the chi square goodness-of-fit test are used to select which of the distribution models best describes the data. The major problem of determining the relationship between the life characteristics of electronic devices and the operating conditions they are subjected to is discussed. The coefficients of over 44 postulated regression models are estimated. Dissert. Abstr.

N68-37751*# General Electric Co., Schnectady, N. Y. Microwave Tube Business Section.
ANALYTICAL DESIGNS OF A SPACE-BORNE MAGNETICALLY-FOCUSED KLYSTRON AMPLIFIER Final Report
G. M. Branch and T. G. Mihran 25 Oct. 1968 229 p 33 refs
(Contract NAS3-11514)
(NASA-CR-72461) CSCL 09A

An analytic study leading to the development of high-efficiency magnetically-focused klystron designs for use in satellite-borne television broadcasting service is reported herein. An accurate and detailed large-signal computer simulation of a klystron was employed for developing space-adapted, heat-pipe cooled klystron designs having internal conversion efficiencies in excess of 60 percent and meeting all specifications for phase linearity, gain, power output and bandwidth. During the course of the study, a new principle of reflex collection of the spent beam at reduced collector potentials was discovered. Preliminary analyses of the collector indicates that a power klystron with a reflex depressed collector could have an overall stable output-power efficiency in excess of 80 percent in FM television service. The computer klystron gain and overall efficiency characteristics while transmitting a television signal at average picture levels in the five services considered are included. Author

N68-37902*# Texas Instruments, Inc., Dallas.
SIXTY-GHz INTEGRATED RF HEAD
Stan Jones, Shing Mao et al Aug. 1968 87 p 19 refs
(Contract NAS12-555)
(NASA-CR-86109; TI-03-68-50; ISR-1) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The requirement of this contract is to develop the technology to fabricate a monolithic integrated 60 GHz receiver. Investigation of the electrical characteristics of the GaAs substrate has been carried out, and discrete active devices such as Gunn diodes and Schottky barrier diodes have been fabricated. Measurements of these devices, incorporated into oscillators and mixers, gave the following results: (1) a monolithic single-ended mixer tested as a detector had a minimum detectable signal (M.D.S.) of −54 dBm/Hz at 87 GHz; (2) a balanced mixer had a M.D.S. of −125.5 dBm/Hz at 69 GHz; and (3) a monolithic Gunn oscillator gave an output of 1.5 mW at 28 GHz. These results show that this approach is feasible, but much additional development work is necessary before practical receivers are a reality. Author

N68-37944*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRICAL STRESS ANALYSIS OF A MICROTHRUSTOR POWER CONDITIONER
Vincent R. Lalli Washington Nov. 1968 23 p refs
(NASA-TM-X-1686) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Obtaining suitable power conditioning equipment for propulsion experiments is a critical problem. Data obtained on several space projects indicated that failure was caused partly by overstressed electrical parts. A microthruster power conditioner was experimentally analyzed to reveal the problems associated with worst case overstressed parts. The power conditioner was then modified to eliminate these existing overstressed conditions and has since operated continuously for more than 7000 hours. Author

N68-37947# Hughes Research Labs., Malibu, Calif.
A 3.2 MILLIMETER WAVE OSCILLATOR Final Report, 1 Oct. 1966–30 Sep. 1967
Robert P. Bryan Sep. 1968 57 p refs
(Contract DA-28-043-AMC-02225(E))
(ECOM-02225-F; Rept.-9; AD-674647) CFSTI: HC $3.00/MF $0.65

The program involved the development of a permanent magnet focused 10 kW pulsed distributed interaction klystron which operates at 3.2 mm. This tube, designated HOW-2, has demonstrated through environmental and life test programs the capability of withstanding rough environments and an operating lifetime in excess of 2000 hours. All three of the tubes delivered under this contract successfully demonstrated the desired 10 kW of peak output power at a frequency of 93.75 plus or minus 1 GHz and a capability of operating at a 0.0005 duty cycle with a 25 nsec pulse width. The output power and frequency are determined by a cathode voltage pulse in the range 20 to 35 kV. The tube package weighs 37 lb and the collector is air cooled. Author (TAB)

N68-37956# Army Electronics Labs., Fort Monmouth, N. J.
DESIGN CONSIDERATIONS FOR RELIABLE OPERATIONS OF ADD-ON AMPLIFIER AM-4306
Dennis W. Bowman Aug. 1968 16 p refs
(ECOM-2995; AD-674657) CFSTI: HC $3.00/MF $0.65

The purpose of the report is to describe some causes of poor transistor reliability in RF amplifiers, in particular the AM-4306. The report will examine the AM-4306 as it was originally designed and describe its shortcomings as theorized by the investigator. Modifications made to the AM-4306 to correct these shortcomings will be described and the results of testing provided. The results of this testing will serve to prove the hypothesis as to the causes of transistor failure. Author (TAB)

N68-37975# TRW Systems, Redondo Beach, Calif.
INVESTIGATION OF RADIATION HARDENED CIRCUIT ELEMENTS
Larry Scott 15 Jun. 1968 39 p refs
(Contract F19628-67-C-0262)
(TRW-06415-6003-R000; AFCRL-68-0372; SR-4; AD-674632)
CFSTI: HC $3.00/MF $0.65

This is the fourth scientific report on the investigation of radiation hardened insulated gate field effect devices. A very thin, dielectric isolation bounded volume of single crystal silicon is used in constructing an insulated gate field effect transistor. Radiation testing of these devices has been achieved using a neodymium doped glass rod laser, a linear accelerator of electrons (a Linac), and a flash X-ray facility, with the emphasis on the transient radiation effects. Permanent effects, particularly the shift in threshold voltage values, were also monitored. A comparison of bounded volume metal-oxide-silicon transistors (BVM) with conventionally constructed metal-oxide-silicon transistors (MOS) has shown that the BVM is at least an order of magnitude harder than the conventional MOS using peak photo current as the criteria. The threshold shifts are similar for a given absorbed dose. Author (TAB)

N68-37981# Stanford Univ., Calif. Systems Techniques Lab.
A TUNNEL-DIODE HARMONIC-MODE MIXER Interim Technical Report, Apr. 1966–Mar. 1968
Apr. 1968 46 p refs
(Contract DAAB07-68-C-0149)
(SU-SEL-68-033; TR-1908-1; AD-674221) CFSTI: HC $3.00/MF $0.65

The report describes the theoretical and experimental investigation of a tunnel-diode harmonic-mode mixer, which has an IF frequency given by the difference between the RF signal and the second harmonic of the local oscillator frequency. This harmonic mode of operation would allow use of a local oscillator at a subharmonic rather than at the fundamental frequency in conventional superheterodyne receivers. The experimental S-band mixer built employs two directional filters, which inherently lend themselves to terminating a tunnel diode. The mixer, which utilizes a germanium tunnel diode and 50-ohm terminations, exhibits low local oscillator power requirements and has a fairly low conversion loss. The theoretical investigation indicated possible means for improving the mixer performance. Author (TAB)

N68-38085# Radio Corp. of America, Somerville, N. J.
HIGH PERFORMANCE THIN FILMS FOR MICROCIRCUITS Final Report, 1 Mar. 1965–28 Feb. 1968
Morton L. Topfer, Joseph M. Mitchell, and Robert L. Schelhorn Aug. 1968 100 p refs
(Contract DA-28-043-AMC-01230(E))
(ECOM-01230-F; Rept.-12; AD-674216) CFSTI: HC $3.00/MF $0.65

Processing of hafnium and hafnium-dioxide thin-film components is described. Batch anodization techniques are outlined which were used to form resistors and capacitors suitable for microcircuit work on silicon with pattern line widths as narrow as 0.5 mil. Resistance values exceeding 30,000 ohms/sq were achieved and stability data on hafnium thin-film resistors is presented. Temperature coefficient of resistance (TCR) vs sheet resistivity curves have been plotted for resistors fabricated on both glass and glazed alumina substrates. Temperature coefficient of capacitance (TCC) values ranging from +300 to +400 ppm/C have been noted for hafnium-dioxide capacitors. The temperature coefficient of dissipation (TCD) for these elements is in the order of +1%/C. From the measurements obtained, a dielectric constant of 36 was calculated for hafnium-dioxide. Attempts of fabricating a complete circuit employing an all hafnium technology is described. Problems encountered with multilayer sputtering are noted and evaluated. Author (TAB)

N68-38135# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW CABLES
Tzu-Tu Lung 29 Nov. 1967 9 p Transl. into ENGLISH from K'o Hsueh Hua Pao (Chinese People's Republic), no. 6, 1965 p 182–183
(FTD-HT-23-1006-67; AD-673928)

The report reviews new developments in the field of cable manufacture, viz. oil-filled cable, cables having an insulating layer made of foam polyethylene plastic or silicon rubber, rf coaxial cable, and the use of waveguides for long-distance communications. Author (TAB)

N68-38137# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ESTIMATE OF THE RELIABILITY OF SCHEMES WITH PERMANENT REDUNDANCY UNDER CONSIDERATION OF THE POSSIBILITY OF A DEPARTURE OF THE SYSTEM PARAMETER BEYOND THE TOLERANCE LIMITS [OTSENKA NADEZHNOSTI SKHEM POSTOYANNOGO REZERVIROVANIYA S UCHETOM VOZMOZHNOSTI UKHODA PARAMETRA SISTEMY ZA PREDELY DOPUSKA]
A. M. Margulis 28 Nov. 1967 20 p refs Transl. into ENGLISH from Avtomat. i Vychislitelnaya Tekhn. (USSR), no. 11, 1965 p 199–214
(FTD-HT-23-998-67; AD-673927)

Constant redundancy represents one of the methods for improving system reliability, the failure of any of the elements however, results in a change in the output parameters. The author investigates the determination of the probability of failure-free operation of constant redundancy systems up to a specific time, provided the output parameter of the system remains within the limits of tolerance. The solution is presented and the case of small tolerances in the output parameters is discussed. The spread in parameters of individual elements is taken into account and illustrative examples cover the case of short circuits and of interruptions. TAB

N68-38200*# Ohio Semitronics, Inc., Columbus.
STUDY OF TRUE-PRODUCT MODULATORS Final Report, 9 Jun. 1967–30 Mar. 1968
W. E. Bulman and J. Sanborn 31 May 1968 53 p
(Contract NAS8-21187)
(NASA-CR-98053) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A survey, testing of available devices, and development of a breadboard true product modulator based upon the Hall effect are described. Investigations showed that carrier suppression as high as 80 db. could be obtained for carrier frequencies up to 250 kHz on the Ohio Semitronics Inc. MC-521A unit. Good stability with temperature was noted in the range of −20°C to +70°C. Single sideband investigations confirmed that two Hall effect units could be used to provide selectable sideband operation with over 55 db. suppression of unwanted sideband and other possible modulation products. A breadboard modulator unit providing over 1 volt output with input drive currents below 100 ma. is described. True product modulators with exceptional properties can be made using Hall effect principles; such units should be useful in telemetry and communication areas where the elimination of bulky filters, or the introduction of new modulation techniques may provide improvement in equipment. Author

N68-38287# Western Reserve Electronics, Inc., Cleveland, Ohio.
DEVELOPMENT OF CABLE TEST SET FOR CABLE CX-4566( )/G Interim Report, 11 Nov. 1967–10 Jul. 1968

Clarence J. Harsa Aug. 1968 7 p
(Contract DAAB07-67-C-0390)
(ECOM-0390-3; Rept.-3; AD-674247) CFSTI: HC $3.00/MF $0.65

The report discusses the design decisions and work performed in the development of a cable test set for Cable CX-4566()/G. During this period four engineering models of the cable test set were built and thoroughly tested for electrical and environmental compliance to the design objectives as specified in SCL-7871, Electrical Cable Test Set for Cable CX-4566()/G. Author (TAB)

N68-38317# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR CORRECTING MULTIPLE INDEPENDENT ERRORS IN DUAL CONTROL [USTROISTVO DLYA KORREKTSII MNOGOKRATNYKH NEZAVISIMYKH OSHIBOK V DVOICHNYKH KODAKH]
E. T. Mironchikov et al 8 Sep. 1967 7 p Transl. into ENGLISH from Soviet Patent No. 154718 (Appl. No. 725381/26, 7 Apr. 1961) p 1-3
(FTD-HT-23-546-67; AD-674314) CFSTI: HC $3.00/MF $0.65

A device is proposed for correcting multiple independent errors in dual codes. It contains code filters, selector, delay line and summator by modulus two, and is characterized by the fact, that for the purpose of simplifying operations of revealing error points and to simplify the construction code filters are used. TAB

N68-38318# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRONIC OSCILLATOR OF NANOSECOND PULSES [ELEKTRONNYI GENERATOR NANOSEKUNDNYKH IMPULSOV]
A. D. Sushkov 9 Nov. 1967 5 p Transl. into ENGLISH from Soviet Patent No. 168756 (Appl. No. 86018T/26-9, 9 Oct. 1963) 2 p
(FTD-HT-23-974-67; AD-674318) CFSTI: HC $3.00/MF $0.65

The oscillator uses a klystron. It is designed to operate at reduced excitation power during separate excitation, achieve self-excitation, and decouple the output section from the oscillating system. Accordingly, the klystron is provided with three or more hf gaps, two of them connected to two identical resonators, which in turn are interconnected by a feedback line. The remaining gaps are connected to the output section. TAB

N68-38485# General Electric Co., Syracuse, N. Y.
LARGE-AREA ELECTRONICS DISPLAY PANEL Final Report, 1 Jun. 1965-31 Jan. 1968
J. W. Brouillette, R. B. Gethmann, A. W. Edson, and M. L. Noble Ft. Monmouth, N. J. Army Electron. Command Jun. 1968 429 p
(Contract DA-36-039-SC-90755)
(ECOM-01288-F; Rept.-21; AD-674779) CFSTI: HC $3.00/MF $0.65

The objective of the project is to advance the state-of-the-art of Large-Area Electronic Display by developing a new high resolution electron beam deformation system for thermoplastic film and a novel optical projection system. An integrated display model of the Large-Area Electronic Display Panel was built and demonstrated at three formal demonstration sessions. This integrated display model employs a high resolution, magnetic deflection electron gun, developed specifically for this type of application. Use of a TIRP optical system permits optical projection from the writing station with the electron gun mounted normal to the record. This configuration also permits an overwrite capability where the electron gun may write a number of records in sequence over a period of time. Choice of thermoplastic as the recording and display medium gives image storage with a useful viewing time, in the present system, from several minutes up to one-half hour, depending upon the thermoplastic temperature. A specifically designed 70 mm shearing-oil tape transport, consistent with the internal reflection optical system, provides the fast tape pull required to hold the record up-date time approximately one second. The TIRP optical system, employs a lenticular condensing system to uniformly illuminate the 50 x 50 mm thermoplastic record on the TIRP prism. A TIRP projection system projects the strongly immersed record on the TIRP prism to an 8 x 8 foot screen at a 20 foot throw by employing a transfer lens, fiber prism, projection lens and focus lens. With a 4 kw xenon arc-lamp, this system could deliver approximately 4,000 lumens to the screen. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-37459 Montana State Univ., Missouri.
TIME OPTIMAL AND SUBOPTIMAL CONTROL OF SAMPLED DATA SYSTEMS
John Leonard Pokoski (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-2904

Linear and nonlinear sampled-data systems with a minimum-time performance measure were studied. Time-optimal control schemes for systems having input saturation are reviewed, and it is shown that for practical systems, there is generally a substantial cost advantage gained by relaxing the minimum-time requirement. Methods of measuring the amount of "suboptimality" of such systems are then proposed. A time-loss hypothesis is indicated between the minimum times for continuous and sampled-data systems constrained by input signal saturation. The theory of deadbeat response of linear systems is extended to parabolic inputs with minimum squared error restrictions on the step and ramp responses. Minimizing only the sum of the squared ramp errors (subject to the parabolic deadbeat restrictions) also minimizes the maximum ramp error. No such relationship exists if the sum of the squared step errors is minimized. Design methods are presented for digital controllers which provide tradeoffs between the number of sample periods to deadbeat response to a parabolic input and either (1) minimum sum of squared ramp errors, (2) minimum sum of squared step errors, or (3) minimum-maximum step error. Dissert. Abstr.

N68-37475 Purdue Univ., Lafayette, Ind.
ON THE DESIGN OF SPECIFIC OPTIMAL CONTROLLERS
Syed Murtuza (Ph.D. Thesis) 1967 85 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-16687

The design of linear constant coefficient specific optimal controllers for linear, multivariable and time variant systems with inaccessible states is presented. The performance index chosen is a quadratic functional of both state and control variables. For time invariant cases it is shown that when the coefficients of the specific controller are properly chosen, the resulting system is guaranteed to be stable. Since the optimal values of the control parameters for a fixed configuration controller depend on the initial states of the system, the approach taken is to determine the best

value of the parameters for the most unfavorable initial states. A computational method is developed and the convergence properties of the computational algorithm are investigated and the limitations of the step size for convergence are given. The computational algorithm is applied to several examples to test the theory and to demonstrate the improvement in the results when compared to other methods. One of the examples consists of a time varying system. The time varying nature of the problem does not cause any additional difficulties. Dissert. Abstr.

N68-37479 Stanford Univ., Calif.
SYNTHESIS OF LUMPED-DISTRIBUTED RC NETWORKS
Tadikonda Narasimha Rao (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-17489

The synthesis is considered of n-port networks formed by the arbitrary interconnection of uniformly distributed RC lines, lumped resistors and capacitors. By transformation of the true complex frequency variable into two suitable variables, the impedance matrix of a lumped distributed RC n-port is shown to have the two variable reactance property in the new variables. The realizability conditions for such n-ports are formulated in terms of the two variable theory, and a synthesis technique is developed by means of which any realizable n x n impedance matrix can be realized. The realization takes the form of a network consisting of distributed RC lines which is loaded with a suitable number of lumped resistors and capacitors. A simple algebraic method stemming from ideas in minimal state variable realization theory is developed for the synthesis of two variable reactance matrices. The method uses a minimum number of s-type and p-type reactances, and its use in the synthesis of a lumped-distributed RC network is illustrated by an example. Dissert. Abstr.

N68-37583*# Digital Programming Services, Inc., Boston, Mass.
DEVELOPMENT OF NETWORK ANALYSIS FOR SYSTEMS APPLICATION PROGRAM (NASAP) Final Report
Russell C. Serbagi 1968 15 p
(Contract NAS12-564)
(NASA-CR-86099) CFSTI: HC $3.00/MF $0.65 CSCL 09C

NASAP is a network analysis program to solve linear RLC circuits, for the transfer function. The transfer function is the ration of two polynomials in S. The program will evaluate the transfer function over a prescribed frequency range. A time response to an input pulse is generated from zero time to a prescribed final time. The input rules are described and examples of their use are shown. There is no attempt made to discuss any theoretical aspects of the program. Author

N68-37590 Missouri Univ., Columbia.
TOPOLOGICAL ANALYSIS OF GENERAL LINEAR NETWORKS
Maw-Tsuey Jong (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-3618

Topological analysis is presented of general linear networks which may contain any type of dependent sources, gyrators, coupled coils, and ideal transformers. Topological formulas are derived for the node-determinant and its cofactors of such networks. The node-determinant of such networks is given by the sum of common-tree products of voltage graph and the current graph where the sign of each common-tree product takes the value of +1 or −1 which can be determined by some algorithm. Formulas are developed which express the node determinant of a linear network N containing v voltage-controlled current sources, in which the passive reciprocal subnetwork is called N_p. The subnetwork consisting of the controlled current sources is called N_s, in terms of the tree admittance products of N_p and the product of all combinations of k transadmittances of N_s and (k+1)-tree admittance products of N_p where k = 1,2,...,v. Dissert. Abstr.

N68-37592 Northwestern Univ., Evanston, Ill.
APPLICATION OF STOCHASTIC APPROXIMATION METHODS TO THE DESIGN OF PATTERN CLASSIFIERS
John Montague Schumpert (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-3219

Stochastic approximation methods are used to develop iterative design procedures for two-category and multi-category pattern classifiers. The patterns are assumed to be random quantities with unknown probability distributions, and the classifiers are realized by a set of discriminant functions which are of fixed form but have adjustable parameters or weights. Several criteria for an optimal set of weights are studied, and algorithms, based on these criteria, are developed for iterative adjustment of the weights. It is assumed that a sequence of sample patterns, of known classification, is available for observation, and these sample patterns are used, as specified by the algorithms, for adjusting the weights. Sufficient conditions are found, in terms of the pattern statistics, for the convergence of algorithms based on mean-square error criteria, and estimates of the rate of convergence of these algorithms are obtained. Performance of the algorithms is demonstrated through computer simulation. Dissert. Abstr.

N68-37593*# National Aeronautics and Space Administration, Washington, D. C.
CERTAIN THEORETICAL PROBLEMS OF WIDEBAND OSCILLATORS
F. A. Vodop'yanov Oct. 1968 123 p 64 refs Transl. into ENGLISH of the Book "Nekotoryye Voprosy Teorii Shirokodiapazonnykh Generatorov" Moscow, Acad. of Sci. USSR, Radio Eng. Inst., 1964 p 1-150
(NASA-TT-F-11437) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Expressions are derived for the quantitative evaluation of nonlinear error correction, the influence of nonlinear and parametric effects in reactive elements, parametric and short frequency oscillations, the relationship of frequency to rate of parameter modulation, and for the filtering properties of a self-oscillator. The analysis is carried out by the method of integral equations and statistical processing of the reactions of a self-oscillator to delta pulses of the anode current. Author

N68-37612 University of Southern Calif., Los Angeles.
VARIABLE-THRESHOLD THRESHOLD ELEMENTS
William Stuart Meisel (Ph.D. Thesis) 1967 176 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 67-17684

A threshold element is a mathematical model of certain types of logic gates and of a biological neuron. Much work has been done on the subject of threshold elements with fixed thresholds; this study concerns itself with elements in which the threshold may be varied; variable-threshold threshold elements. Physical realizations include resistor-transistor elements, in which the threshold is simply a voltage. Variation of the threshold causes the element to realize varying Boolean functions. The paper considers in depth the nature of the set of functions generated by a single variable-threshold threshold element as the threshold is varied and by a net of such elements, and methods of synthesizing a given set of functions by a single element or a net of elements. Single variable-threshold threshold elements are treated in greatest detail. Dissert. Abstr.

N68-37615*# Colorado Univ., Boulder. Dept. of Electrical Engineering.
OPTIMUM LINEAR ADAPTIVE DESIGN OF DOMINANT TYPE SYSTEMS WITH LARGE PARAMETER VARIATIONS
I. Horowitz 1968 24 p 9 refs
(Grant NGR-06-003-083)
(NASA-CR-97314) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This paper presents a significant improvement over the hitherto available linear dominant system design techniques for guaranteeing system response within prescribed bounds, despite large plant parameter variations. Noteworthy features of the new technique are: (1) the mapping of the plant parameter space into the closed-loop system space is exact and permits application to a much wider and more realistic class of problems than previously possible; and (2) it is shown how the loop transmission bandwidth may be made very much smaller than in the previous designs, thus considerably extending the applicability of the dominant approach, because of its drastically reduced sensitivity to internal noise. Author

N68-37632 New Mexico Univ., Albuquerque.
CONTROLLABILITY AND OPTIMAL CONTROL OF BILINEAR SYSTEMS
Raymond Edward Rink (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-3479

The topic of this dissertation is the class of systems which are called bilinear. Such systems are linear in the state variables and linear in the control variables, but not jointly linear in both. The dynamical equations which define a bilinear system are given. The nuclear reactor and the respiratory chemostat are discussed, as examples of physical processes which have inherently bilinear models. Concerning other processes which are inherently linear, it is proposed that an added bilinear mode of control can yield improved controllability and improved performance. Consideration is given to the derivation of conditions sufficient to ensure complete controllability for a bilinear system. The important concept of the equilibrium set of a bilinear system is introduced and developed. The optimal control of a particular bilinear system, a second-order regulator where the damping term can be switched on and off is discussed. Dissert. Abstr.

N68-37668 Minnesota Univ., Minneapolis.
DIRECT METHOD OF LYAPUNOV AND TRANSIENT STABILITY ANALYSIS
Muhammad Waheeduddin Siddiqee (Ph.D. Thesis) 1967 136 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-1594

Transient stability analysis of electric power systems using the direct method of Lyapunov has been studied in considerable detail. Various existing methods of constructing Lyapunov's functions have been examined with particular reference to the differential equations of electric power systems. A modified method combining the methods of Ingwerson and variable gradient method has been proposed which is especially suited for problems involving transcendental terms such as encountered in power system equations. Using this method in combination with some trials based on physical considerations, Lyapunov functions have been developed for the stability analysis of the following typical cases: (1) single machine problem including the effects of flux decay, governer and voltage regulator action; (2) two machine problem including the effects of flux decay and governor action; and (3) general N machine case. Dissert. Abstr.

N68-37719# Boeing Co., Renton, Wash. Airplane Div.
ADAPTIVE CONTROLS: A SURVEY AND A SIMULATION STUDY
Leon O. Billig 29 Dec. 1967 103 p 29 refs
(D6-20379; AD-672025)

The outline of this report will follow, approximately, the functional evolution of control systems. This functional evolution will be traced through the following steps: (a) Linear controls, i.e., controls that perform linear operations upon the input signal. The transformed input signal then becomes the output signal. (b) Nonlinear controls, i.e., controls that perform nonlinear operations upon the input signal. (c) Preprogrammed modification of the control system parameters that operate on the input signal to produce the desired output. (d) Learning systems that modify their own control parameters as a result of experience. (e) Self-organizing systems that do not operate on the input signals but rather evaluate them and generate output signals based on this evaluation. Author (TAB)

N68-37752 Tulane Univ., New Orleans, La.
IMPLEMENTATION OF NON-INTERACTING CONTROL IN A CONTINUOUS MULTIVARIATE SYSTEM
Jerome Adrian Planchard, Jr. (Ph.D. Thesis) 1967 193 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-4061

Numerous empirical methods for the design of controller parameters have been developed in the past and have gained acceptance through widespread usage. However when these methods, which were developed for single loop control systems, are applied to highly coupled multivariable systems, unsatisfactory system performance frequently results. Within the past ten years, a great deal of multivariable control theory has been developed. Much of this theory has been concerned with one particular aspect of multivariable control, namely non-interacting control. Despite the large body of theory available its practical application has received little attention in the process control field. The object of this work was to physically implement non-interacting control of a multivariable system whose mathematical model included non-linearities, time delay, and greater than first order equations. Such a system consisted of three stirred tanks in series, to which were fed two streams at different fixed temperature. Dissert. Abstr.

N68-37784# Texas Univ., Austin. Electronics Research Center.
BIANNUAL OF ELECTRONICS RESEARCH NUMBER 7, PART 1 Final Report
C. L. Coates May 1968 267 p refs
(Grant AF-AFOSR-766-67)
(AFOSR-68-0890; AD-672003)

The report presents research topics in progress, recent findings, and future plans in the areas of biomedical electronics; information sciences; physical, quantum, and plasma electronics; and acoustics and radio sciences. This seventh biannual is highlighted by new results obtained in several of these areas. Author (TAB)

N68-37843# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
RESEARCH LABORATORY OF ELECTRONICS, QUARTERLY PROGRESS REPORT NO. 90
H. J. Zimmermann, G. G. Harvey, and S. J. Mason 15 Jul. 1968 304 p 14 refs
(Contracts DA-28-043-AMC-02536(E); N00014-67-A-0204-0019; AF 19(628)-5661; AF 19(628)-6066; AT(30-1)-1842)
(QPR-90; AD-673551)

Research activities in the following general areas are reviewed: Molecular beams; microwave spectroscopy; radio astronomy; solid-state microwave electronics; electronic instrumentation; optical and infrared spectroscopy; geophysical research; magnetic resonance; physical acoustics; electrodynamics of media; plasma

physics; gaseous electronics; plasmas and controlled nuclear fusion; spontaneous radiofrequency emission from hot-electron plasmas; interaction of laser radiation with plasmas; statistical communication theory; processing and transmission of information; detection and estimation theory; speech communication; linguistics; cognitive information processing; communications biophysics. TAB

N68-37908*# Chrysler Corp., New Orleans, La.
APPLICATIONS STUDY OF ELECTROADHESIVE DEVICES
Richard P. Krape Washington NASA Oct. 1968 90 p 3 refs
(Contract NAS1-7303)
(NASA-CR-1211) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A summary is presented on studies to determine the feasibility of using electroadhesion as a means for aiding astronauts in performance of on-board and EVA experiments. Mathematical and experimental analyses were conducted to define the factors that control or affect the electroadhesion phenomenon. The parameters analyzed were: resistivity, coating thickness, current density, surface conditions, polarity, temperature, time, environmental conditions, and chemical nature of coating materials. Five types of electroadhesor mountings were investigated; power supply requirements and techniques for controlling electroadhesor operation were studied. Three prototype electroadhesor models were designed, fabricated, and tested to establish preliminary operational data. Evaluation included tests for static pull force, skid force, and battery longevity. In practice, electroadhesion was found to occur when any suitable insulator material was placed between two electrodes charged in a manner to allow a small current to pass from one to the other. The intimacy of the contacting surfaces was found the most difficult condition to establish and maintain. B.P.

N68-37991# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PRACTICAL DESIGNS FOR RC ACTIVE FILTERS USING OPERATIONAL AMPLIFIERS
John W. Craig Aug. 1968 30 p
(Contract AF 19(628)-5167)
(ESD-TR-68-249; TN-1968-26; AD-674599)

Several practical circuits for the design of RC active filters using operational amplifiers are given. The transfer function of each circuit has a pair of complex poles and has transmission zeros either all at infinity, one each at zero and infinity or an imaginary pair at plus or minus omega sub o. More complicated transfer functions can be obtained by cascading these circuits. Design procedures are outlined which minimize the need of capacitor trimming, and the sensitivity of the transfer function to changes in gain of the operational amplifier is minimized. Author (TAB)

N68-38102# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
COMPARISON OF FOUR NUMERICAL ALGORITHMS FOR SOLVING THE LIAPUNOV MATRIX EQUATION
David Rothschild and Antony Jameson Oct. 1968 52 p refs
(RM-425)

This memorandum summarizes four alternative methods for computing the solution to the Liapunov matrix equation. A comparison of the methods is presented, along with computer programs and sample runs. The necessity for solving this equation arises not only in certain phases of nonlinear stability analysis, but also in the design of optimal systems with fixed control structures. A more general form of this equation, which often appears in structural analysis, can be handled directly by one of the methods, and by the others with minor modifications. Author

N68-38125# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
[RESEARCH AREAS IN THE SCHOOL OF ELECTRICAL ENGINEERING] Eighth Semiannual Research Summary Report, Jan.–Jun. 1968
Jun. 1968 125 p refs

An overview is presented on the various research projects being conducted. These include: (1) medical and life sciences with emphasis placed on biological systems and electrophysiology, and speech communications; (2) automatic control theory, learning systems and pattern recognition, analysis procedure for feedback shift registers, generalized multi-threshold threshold logic, and identification and estimation; (3) electrical power systems, such as underground cable energization, load forecasting in power systems, computation of underground cable parameters, power systems dynamics during large disturbances, analysis of extra high voltage systems, and optimum scheduling of power and voltage magnitude; (4) plasma effects on electromagnetic waves and devices, electromagnetic wave scattering by solid objects, optical coherence theory, and electrohydrodynamics; (5) communication sciences, and nonlinear circuits and systems; (6) materials and electronic devices; and (7) interdisciplinary research program on agricultural remote sensing techniques. M.G.J.

N68-38288# Naval Ship Engineering Center, Philadelphia, Pa.
ANALOG COMPUTER INVESTIGATION OF THE 'OFF-LINE' CONTROL CONCEPT Final Report
J. R. Garnett 10 Jul. 1968 50 p refs
(NAVSECPHILADIV-C-19; AD-674503) CFSTI: HC $3.00/MF $0.65

This report describes the investigation of a control scheme in which the output of an integral controller in a feedback path is used to modify the gain of a feedforward control path. This control scheme is referred to as off-line integration. The system used for this investigation was an analog computer simulation of a heat exchanger in which it was desired to maintain the outlet temperature of the heated fluid constant by controlling the flow rate of the heating fluid when the heated fluid flow rate was subjected to increasing and decreasing ramp disturbances. Comparison of the off-line controller to the conventional proportional-plus-integral controller was made on the basis of the minimum integral of the absolute value of the error. Findings indicated a significant improvement in system transient response for the off-line controller. Experimental results are presented as enclosures to this report. Author (TAB)

N68-38349# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUESTION OF RELIABILITY OF STANDBY SCHEMES WITH CONSTANT CONNECTION OF EXTRA UNITS [K VOPROSU O NADEZHNOSTI SKHEM REZERVIROVANIYA S POSTOYANNYM VKLYUCHENIEM IZBYTOCHNYKH ELEMENTOV]
A. M. Margulis 29 Dec. 1967 11 p refs Transl. into ENGLISH from Akad. LatSSR, Inst. Elektron. i Vychislitel'noy Tekhn. Avtomat. i Vychislitel'naya Tekh., no. 9, 1965 p 189–197
(FTD-HT-23-560-67; AD-674334) CFSTI: HC $3.00/MF $0.65

The article considers the reliability of a system consisting of n series-parallel-connected identical elements when the characteristic system parameter S deviates beyond permissible limits as a result of failure of m elements ($m < n$). The system elements may fail due to a break or to a short-circuit; the faultless-operation time of each element has exponential distribution. The probability of failure of an element during delta T is: q = (lambda sub S + lambda sub O) delta T + O(T), where lambda sub S and lambda sub O are the failure intensities of short-circuit and break, respectively. Following the V. Feller methods, a system of linear differential

equations is set up to describe the probability of the transition of a system containing 2 lines with m elements in each into a system containing either 2 lines with a lesser number of elements or one line. A particular case, when the system parameter S can be expressed in terms of the number of lines and elements, is also considered. Finally, the function of distribution of faultless-operation time is found. TAB

N68-38371# RAND Corp., Santa Monica, Calif.
DYNAMIC PROGRAMMING AND OPTIMAL TRAJECTORIES FOR QUADRATIC VARIATIONAL PROCESSES
R. E. Kalaba Aug. 1968 16 p refs
(Contract F44620-67-C-0045)
(RM-5755-PR; AD-674587)

Dynamic programming provides a standard tool for determining optimal feedback control policies for linear systems with quadratic measures of cost. The situation has been less satisfactory, however, with regard to optimal trajectories. A one-sweep initial-value method is presented in this study for determining both optimal policies and optical trajectories. It is shown also that the solution of the Cauchy problem satisfies the Euler equation and the boundary conditions. Author (TAB)

N68-38429# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE OPTIMUM METHOD OF PATTERN RECOGNITION FOR MUTUALLY CORRELATED CHARACTERISTICS [OB OPTIMALNOM METODE OPOZNANIYA OBRAZOV PRI VZAIMNOKORRELIROVANNYKH PRIZNAKAKH]
I. T. Turbovich 16 Nov. 1967 14 p refs Transl. into ENGLISH from the book "Opozanaie Obrazov: Teoriya Peredachi-Informatsii" Moscow, Izd. An SSSR., 1965 p 3-10
(FTD-HT-23-962-67; AD-674317) CFSTI: HC $3.00/MF $0.65

In various papers dealing with the design of recognition machines the undimensional distribution functions are established after sampling, then assuming the characteristics are truly independent, the multidimensional distribution function is found. In this case the machine applies the minimization of error probability. In practice, however, it is in general impossible to establish a sufficiently complete system of uncorrelated characteristics. Consequently, the present author discards the statistical approach. The optimization criterion of the recognition machine is sought in the minimum of the number of standards needed for comparison (i.e., the simplicity of the recognizing device) rather than in the minimum of the error probability. The minimum of the number of standards is found by means of the so-called association function. Each point in the space of the characteristics is described by the totality of standard-associating functions. The standard-associating function of an arbitrary pattern is positive if the point of the space of characteristics under consideration is closer to that standard than an arbitrary realization of another pattern; otherwise, the associating function is equal to zero. TAB

N68-38488# Institut fur Plasmaphysik G.m.b.H, Garching (West Germany).
STUDIES ON RESONANT RING CIRCUITS [UNTERSUCHUNGEN AN RINGHOHLRAEUMEN]
O. Gehre and M. Tutter Apr. 1968 16 p refs In GERMAN; ENGLISH summary
(IPP-3172) CFSTI: HC $3.00/MF $0.65

A resonant ring circuit was analyzed: in a transmission line with constant frequency, and in the feedback line of a feedback-amplifier-oscillator. For experimental demonstration, in the former case an X-band waveguide circuit was used, and in the latter case a coaxial line circuit in the 500 MHz-range was used. Author

N68-38492# Syracuse Univ., N. Y. Dept. of Electrical Engineering.
INSTABILITY OF PERIODICALLY TIME-VARYING LINEAR CONTROL SYSTEMS
Theodore A. Bickart Griffiss AFB, N.Y. RADC 30 Aug. 1968 17 p refs *Its* SIAM Jr. Control Paper, Vol. 6, No. 1, 1968
(Contract AF 30(602)-3538)
(RADC-TR-68-283; AD-674618)

Instability of periodically time-varying linear control systems. TAB

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-37523 West Virginia Univ., Morgantown.
DESIGN AND OPERATION OF THE W.V.U. 2-1/2 INCH SHOCK TUBE
Richard Edison Walters (Ph.D. Thesis) 1967 168 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-2698

It is not the purpose of this report to duplicate the substantial amount of theoretical and experimental information which may be found in the literature, but rather to describe the design, construction, instrumentation, and operation of a simple general-purpose shock tube, in use in the Aerodynamics laboratory of West Virginia University. The basic purpose of this device is to provide a tool for undergraduate education, both in laboratory courses and for use on individual projects. The shock tube is also used for graduate student instruction and theses investigations. The report also gives results of tests which were performed in order to investigate the shock tube when used as a wind tunnel. Results, in general, have been encouraging. It appears that cost savings and much more versatility can be realized with shock-tube wind tunnels when compared with conventional tunnels in the range of Mach numbers from 0 to 2. Tests results for the calibration of a free jet issuing from the end of a shock tube, and for the drag coefficient of a sphere, are included. Dissert. Abstr.

N68-37675# Uppsala Univ. (Sweden). Inst. of Physics.
COMPUTER DESIGN AND OPTIMIZATION OF IRON CORED PARTICLE FOCUSING DEVICES
Bengt Olsen, Cengiz Besev, and John S. Colonias (Calif. Univ., Berkeley, Lawrence Radiation Lab.) Apr. 1968 38 p 8 refs
(UUIP-586)

A method is described by which the design of particle focusing devices may be facilitated and optimized by using high speed digital devices and modern computing techniques. It is shown that the method described is economical, precise and general, and it also provides the experimenter with the flexibility of designing various models prior to the actual construction of the final instrument. A computer program has been prepared which allows the experimenter to completely design particle focusing devices with or without iron. The programs make use of modern on-line computing techniques to allow the user to interact with the digital device and direct the progress of the solution based on information displayed on a cathode ray tube. Communication with the computer

is made via a light pen and a teletype. It is also shown that the computed fields and the focusing properties of the directional correlation spectrometer, used as an example, compare favorably with those measured. Author (NSA)

N68-37986# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
THE TWO AXIS MOTION GEAR FOR THE BIG SPACE SIMULATION CHAMBER OF THE SPACE SIMULATION INSTITUTE WITHIN THE DVL AT PORZ-WAHN [DER ZWEIACHSEN-BEWEGUNGSSIMULATOR FUER DIE GROSSE RAUMKAMMER DES INSTITUTS FUER RAUMSIMULATION DER DVL IN PORZ-WAHN]
W. Hallmann Jul. 1968 61 p refs In GERMAN; ENGLISH summary
(DLR-MITT-68-16) CFSTI: HC $3.00/MF $0.65

The two axis motion gear is part of the equipment of the big space simulation chamber within the DVL at Porz-Wahn. It is designed so that the motion and position of satellites relative to the sun can be simulated. Extensive experiments on bearings, sealings, and drive for operating under high vacuum were necessary for the shaping of this device. The possibilities and experiences made when constructing a two axis simulator are described in the following. Author

N68-38174# ARO, Inc., Arnold Air Force Station, Tenn.
VARIATION OF WATER AND CARBON DIOXIDE CRYODEPOSIT REFLECTANCES WITH ANGLE OF INCIDENCE AND DEPOSIT THICKNESS Final Report, May 1966–Apr. 1968
B. E. Wood, A. M. Smith, and B. A. Seibert Arnold Eng. Develop. Center Sep. 1968 32 p refs
(Contract F40600-69-C-0001)
(AEDC-TR-68-144; AD-674742)

Cryodeposits which form on the cryogenically cooled walls of a space simulation chamber can change the wall reflectance and thus alter the thermal balance of the test vehicle. In the study, H2O and CO2 cryodeposits of thicknesses up to 1.8 mm were formed on a 77K surface under vacuum. The spectral reflectances of these deposits were measured in situ with an integrating sphere for angles of incidence from 0 to 60 deg. At the smaller deposit thicknesses, the reflectance showed a strong dependence on both thickness and angle of incidence, whereas at larger thicknesses the dependence was less. A theoretical model developed for reflectance determination of absorbing and scattering media gives a good representation of the thickness dependence of water cryodeposit reflectance except at very small thicknesses where interference effects are known to occur. Author (TAB)

N68-38477# Harry Diamond Labs., Washington, D. C.
TEST TIMES IN SHOCK TUBES USING ARGON
Harry J. Davis and John A. Shirley Jun. 1968 20 p refs
(HDL-TM-68-21; AD-674182)

Shock-tube test times taking into account the boundary layer growth in argon are calculated for a variety of tube diameters and initial gas pressures. In addition, the processes involved in establishing flow in a supersonic shock tunnel are discussed. The results of two calculation procedures for determining the starting time in a shock tunnel are compared for a specific example. Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-37439 Tulane Univ., New Orleans, La.
A NUMERICAL SOLUTION OF TRANSIENT COMPRESSIBLE FLOW FROM A DUCT
James William Watts, III (Ph.D. Thesis) 1967 196 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-4077

The hyperbolic partial differential equations that describe discharge of a compressible fluid from a duct into an infinite reservoir are solved using the centered difference method, a finite difference technique employing second order correct analogs centered in time and space. Special modifications of the method, used to describe the discontinuity or shock, involve representing the shock by two grid points which move with it. The Rankine-Hugoniot equations are used to relate the dependent variables across the shock, and the strength of the shock is determined by an iterative procedure. It is concluded that the centered difference method with the modifications developed constitutes a fast, efficient method of solving nonlinear hyperbolic partial differential equations. In particular the description of the shock obtained using these methods is superior to that obtained through other current numerical techniques. Furthermore, the methods developed can readily be extended to other systems of hyperbolic partial differential equations. Dissert. Abstr.

N68-37452# Los Alamos Scientific Lab., N. Mex.
TRANSPORT OF ANISOTROPIC OR LOW-INTENSITY TURBULENCE
Francis H. Harlow 4 July 1968 14 p 9 refs
(Contract W-7405-ENG-36)
(LA-3947) CFSTI: HC $3.00/MF $0.65

Some extensions to the theory of turbulence transport, generalizing the theory to apply to flows with regions of weak turbulence or with strong departures from isotropy are described. Author (NSA)

N68-37458 Tennessee Univ., Knoxville.
A STUDY OF DETACHED TURBULENCE PROMOTERS FOR INCREASING MASS TRANSFER RATES IN AQUEOUS CHANNEL FLOW
Jack Samuel Watson (Ph.D. Thesis) 1967 280 p
Available from Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 68-3774

A rectangular channel was employed at Reynolds numbers from 513 to 5800 (based upon the smaller channel axis). Promoters of three different diameter sizes were tested with three different spacings of the promoter center line from the wall. The experimental technique involved measuring the rate of ferricyanide reduction at a polarized electrode (or test surface) with a large excess of supporting electrolyte (sodium hydroxide). The promoters locally increased the mass transfer rate to as much as eight times the unpromoted rate; the average transfer rate over the entire test surface was increased as much as threefold. For a given increase in mass transfer rates, turbulence promoters required smaller increases in pumping power than would have been required by increased circulation rates in clear, or unpromoted, channels. The maximum promotion occurred at a Reynolds number near the laminar-turbulent transition point. The optimum promoter spacing from the wall appeared to be approximately 1.5 diameters, and the optimum spacing between promoters appeared to be approximately 8.0 diameters. Dissert. Abstr.

N68-37473 Louisiana State Univ., Baton Rouge.
MEASUREMENT AND PREDICTION OF BINARY GASEOUS DIFFUSION COEFFICIENTS
Aziz Ahmed Mian (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17337

An analysis of the existing experimental diffusion data led to the development of empirical prediction equations for binary gaseous systems, and empirical combining rules for the pure component potential parameters obtained from viscosity data. The correlations for the case of nonpolar–polar systems were not as good as for the case of nonpolar–nonpolar systems. A flow through porous plug method was found to be suitable for diffusion measurements of gaseous systems over a reasonable range of temperature. This technique gave effective diffusivities which were reproducible and had very small standard deviation and which when converted to true diffusivities agree with the ones measured. Diffusivities of N_2–HCl, A–HBr, and N_2–HBr systems were measured under constant pressure condition as a function of temperature and compared with those predicted by empirical equations as well as by Hirschfelder's equation. Dissert. Abstr.

N68-37499 Ohio State Univ., Columbus.
SWIRLING LAMINAR FLOW BETWEEN PARALLEL PLATES AND CONCENTRIC CYLINDERS
James Frank Wilson (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-3090

This is a study of axisymmetric laminar flow swirling in the annular gap between fixed concentric cylinders. Swirl flow comes about when the initial velocity has both a circumferential and an axial component, and when a pressure difference is maintained between the ends of the cylinders. The flow is steady, fully developed, and incompressible. Circulation due to a radial component of velocity could have existed, but could not be observed in the experiments. This substantiated the assumption that the radial velocity terms were often negligible. For the particular apparatus used, $\epsilon_0 = 1/33 < 0.05$. With the additional assumption of similarity of velocity profiles, the theoretical calculations for swirl angle agreed with measured values at several Reynolds numbers. Dissert. Abstr.

N68-37501 New Mexico Univ., Albuquerque.
A GENERAL NUMERICAL PROCEDURE FOR SOLUTIONS OF VISCOUS COMPRESSIBLE FLOWS WITH SHOCK WAVES
Edward Frank Staiano (Ph.D. Thesis) 1967 190 p
Available from Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-3483

The purpose was to develop a numerical procedure for calculating the pressures, temperatures, velocities and other variables of a viscous compressible fluid flow field with shock waves. The investigation was composed of a development and an application phase. The development phase was concerned with the generation of a differencing technique for use on systems containing shock waves and laminar boundary layers. The differencing methods originated in the development phase were based on the Lax-Wendroff technique. The techniques were applied on both one and two dimensional systems in cartesian and transformed coordinates. Hyperbolic tangent and logarithmic transformations were used. The application phase was concerned with the verification of the numerical techniques of the development phase. A system composed of an oblique shock wave interacting with a laminar boundary layer on a flat plate was solved numerically. Dissert. Abstr.

N68-37502 Colorado Univ., Boulder.
HYDRODYNAMIC EQUATIONS UNDER NON-LOCAL THERMODYNAMIC EQUILIBRIUM (KINETIC THEORY OF MULTI-COMPONENTS GAS MIXTURE WITH RADIATION EFFECTS)
Shi Tsan Wu (Ph.D. Thesis) 1967 114 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-2635

Attention is directed to some unsatisfactory features of macroscopic equations for the problem of mixture of gases. The main defects are in the region where the non-local-thermodynamic equilibrium (non-LTE) conditions prevail. In this study, an effort has been made to derive a set of macroscopic equations through the macroscopic description of Boltzmann's equation under the conditions of non-LTE. The densities, mean-flow velocities, specific energies, stress tensors, and heat-flow vectors of individual components are considered to be fundamental quantities in this description. To achieve a determined set of macroscopic equations, the component-velocity distribution function is approximated by means of a polynomial expansion with respect to the local thermodynamic variables; namely, with reference to the center-of-mass system. The component velocity distribution functions are then expressed as the product of the distribution functions for the center-of-mass system and the corrections depending on the differences of the temperature and mean-flow velocity of the components with respect to the center-of-mass system. These reduce to a Maxwellian distribution function of the component under the condition of LTE. Dissert. Abstr.

N68-37521 Colorado Univ., Boulder.
A FIRST ORDER NON-AFFINE INTEGRAL SOLUTION FOR THE TWO-DIMENSIONAL INCOMPRESSIBLE LAMINAR BOUNDARY LAYER
Wayne Eugene Simon (Ph.D. Thesis) 1967 50 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-2653

A set of first-order non-affine solutions of the boundary layer equations has been developed. Based on these solutions, approximating equations for the boundary layer growth rate, surface shearing stress, critical Reynolds number and shape factor were developed. The result is the reduction of the computation of boundary layer displacement thickness to the solution of a simple transcendental equation. Surface shearing stress, critical Reynolds number and shape factor may then be computed with simple algebraic expressions. Boundary layer computations using the present integral solution compare very favorably with available numerical solutions of the boundary layer equations and represent a considerable improvement over previously available approximate solutions. Dissert. Abstr.

N68-37549*# National Aeronautics and Space Administration, Washington, D. C.
ON WAVE EXCITATION FREE SHIP FORMS
Seizo Motora and Takeo Koyama Oct. 1968 20 p 10 refs Transl. into ENGLISH from Zosen Kyokai Rombunshu (Tokyo), no. 117 p 115–126
(NASA-TT-F-11832) CFSTI: HC $3.00/MF $0.65 CSCL 13J

A ship hull was designed and tested under actual wave forces in a two-dimensional plane, and some results indicate the measured heaving exciting force. An example of a three-dimensional application using a spherical form is also included; and, while these data are considered preliminary, they are suggested for applications in reduction of hull stresses, motion, and mooring strain on floating objects. M.W.R.

N68-37555 Wisconsin Univ., Madison.
AN ANALYTICAL STUDY OF THE COLLISION OF LIQUID DROPS
Keith Gillingham Damon (Ph.D. Thesis) 1967 204 p
Available from Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 67-10625

The system was described theoretically by the Navier-Stokes equations, restricted to conditions of creeping flow, for the gas

phase surrounding the drops and by a modified form of the Young-Laplace equation at the interface between the drops and the gas phase. Circulation inside the drops is small for this system and was therefore neglected. The inertias of the drops, evaluated by force balances on the system, were assumed to be linearly distributed over the height of the drops. A pseudo steady state analysis was made which required that the drops always be at equilibrium with the surroundings at any point during the approach. The defining equations were numerically solved by allowing the drops to approach each other through a series of discrete steps from selected initial positions. The drag forces acting on the surfaces during a step of the approach were determined from the force balance. Dissert. Abstr.

N68-37584 Northwestern Univ., Evanston, Ill.
AN INTEGRAL REPRESENTATION FOR VISCOUS SURFACE WAVES GENERATED BY STEADY DISTURBANCES
John Philip Dugan (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3173

The problem of interest is the steady motion of a general two-dimensional body below the surface of an infinite viscous fluid. With an Oseen approximation, integro-differential equations are first obtained for the solution due to a concentrated force moving below the surface. These equations are solved by Fourier transforms and the solutions are utilized to formulate the general underwater body problem. Thus, integral equations are obtained for the local drag and lift on the underwater body. As an illustration of the method, a small horizontal flat plate moving well below the surface is considered. The drag on the plate and the resulting surface waves conform to what may be expected. Dissert. Abstr.

N68-37598 Rensselaer Polytechnic Inst., Troy, N. Y.
THE LINEARIZED RAYLEIGH PROBLEM IN A RARIFIED GAS FLOW ACCORDING TO THE BGK MODEL
K. S. Nagaraja (Ph.D. Thesis) 1966 104 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-9293

The classical Rayleigh problem has been formulated using the BGK kinetic equations, and the numerical evaluation is carried out on an IBM 7094. The results describe the macroscopic velocity q_x, the shear stress P_{xy}, the tangential heat flux Q_x, and the temperature field T' in the near-free molecule flow. These results are obtained for a wide range of values of λt (the number of inter-molecular collisions in a time t). The flow picture is physically plausible and agrees in regions of common validity with other available results. For example, the velocity-slip on the surface, which is half of the impulsive velocity V in the free-molecule limit, decreases with increasing collision numbers (λt), and finally vanishes in the Rayleigh limit (or the continuum limit). The boundary layer thickness also decreases with increasing λt. The initial formulation of the problem involves only first power of q_x. Using a higher approximation by retaining the q_x^2 term, the temperature fields are obtained for the near-free-molecule flow. The compressibility effects may be included through an iteration scheme. Dissert. Abstr.

N68-37643 Princeton Univ., N. J.
SPECIES SEPARATION BY STAGNATION OF GAS MIXTURES IN SUPERSONIC FLOW
John Hu-sen Chang (Ph.D. Thesis) 1967 137 p
Available from Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-2464

The gas composition was measured at the stagnation point of probes immersed in hypersonic low density binary gas mixtures. The probes had a hemisphere-cylinder configuration. The flow field was provided by a freely expanding jet from a sonic nozzle. Under certain documented conditions stagnation point gas compositions were substantially higher in heavier species than the free stream gas. A wide range of data on species separation could be correlated in terms of free stream gas properties and characteristic probe dimensions. Some qualitative arguments consistent with the experimental results confirm the suggestion that the detached shock wave and the associated flow field in front of the probe are primarily responsible for the observed separation. This separation is consistent with the observation that stagnation point recovery factors are substantially higher with gas mixtures than with pure gases. Dissert. Abstr.

N68-37653 Iowa State Univ. of Science and Technology, Ames.
THE PROFILE OF A LIQUID DROPLET DURING FORMATION AND SEPARATION
James Edmund Halligan (Ph.D. Thesis) 1967 66 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-2826

The profile of a forming droplet was determined using a pressure balance which was similar to that derived by Laplace for the static droplet. A term was added to the balance to account for the pressure on the interface due to the motion of the fluid within the droplet. The entire pressure balance was then combined with differential equations describing the geometry of the droplet. Computed profiles compared favorably with those obtained experimentally. An additional result was the definition of a parameter f indicating the importance of internal fluid motion on the shape of the profile. A method of estimating this parameter without solving the equations was developed. The computed and experimental profiles were similar until the droplet developed a minimum value in the profile. Dissert. Abstr.

N68-37676 South Carolina Univ., Columbus.
INTERACTION OF A TWO DIMENSIONAL JET WITH A DEFLECTING STREAM
Edwin Freeman Coxe (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3927

The accuracy of the solution was determined by comparing the numerical results with experimental results of a deflected jet in a confined channel. Numerical solutions were also obtained for unconfined deflected jets and used to explain the discrepancy between the inviscid solutions and experimental results reported in the literature. Reasonably good agreement was found between the predicted jet profiles and those obtained experimentally. The inviscid solutions were shown numerically to be a limiting case of the viscous solutions. The inviscid pressure distribution disagreed significantly with that obtained numerically, the latter being more consistent with reported experimental results for three-dimensional jets. Recommendations are made for a more natural coordinate system which would permit examining the jet in much finer detail than is permitted with a Cartesian system. A suggestion is also made for a means of extending the analysis to three dimensions. Dissert. Abstr.

N68-37679 Rensselaer Polytechnic Inst., Troy, N.Y.
FREE-SURFACE INSTABILITY OF A LAYER OF SECOND-ORDER LIQUID FLOWING DOWN AN INCLINED PLANE
Loi-lou Ting (Ph.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-847

The investigation is concerned with the free-surface instability of an incompressible second-order fluid film flowing down an inclined plane under the action of gravity. Applying linear hydrodynamic stability theory, the eigenvalue problems governing the stability of the flow are derived for the cases where the

disturbances propagate along the direction of the main flow (two-dimensional disturbances) and oblique to the main flow (three-dimensional disturbances). Long wave solutions for both cases are obtained by the method of asymptotic expansion. Direct numerical method is used to compute the neutral stability curves, damping, and amplification curves for various parametric values for the case of two-dimensional disturbances when wavenumbers are not small. The investigation is limited to the study of the free-surface modes. The results show that, for two-dimensional disturbances, the presence of viscoelastic coefficient lowers the values of the critical Reynolds number. The cross-viscosity displays no effect on the stability of the flow. Dissert. Abstr.

N68-37718 Tulane Univ., New Orleans, La.
THE NUMERICAL SOLUTION OF A TWO DIMENSIONAL MOVING BOUNDARY PROBLEM
John Elbert Stack, III (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-4067

Finite difference techniques are used to develop a numerical solution for an unsteady draining process with simultaneous vapor condensation. Four equations are involved and are solved in three dimensions, two in space and one in time. There are four independent variables, one of which is the position of the moving film. An improved solution for the corresponding isothermal drainage problem was developed by utilizing boundary layer theory. An investigation of iteration procedures used in the solution has general applicability to sets of non-linear partial differential equations. A model for the general problem involving vapor condensation at the interface was developed and the corresponding numerical solution was obtained. This gives the position of the boundary at all times as well as values of the velocities and temperatures. Dissert. Abstr.

N68-37740 Virginia Polytechnic Inst., Blacksburg.
THE RADIAL MIGRATION OF SOLID SPHERES IN COUETTE SYSTEMS
John Stephen Halow (Ph.D. Thesis) 1968 358 p
Available from Univ. Microfilms: HC $16.20/Microfilm $4.60 Order No. 68-2049

The radial migration phenomena associated with single spheres suspended in a viscous liquid contained in a Couette system was studied. A theoretical prediction of the migration was developed and experimental measurements of the trajectories were reported. The ratio of the diameter of the sphere to the annular thickness of the Couette region was found to have the largest effect on the migration. A dependence on the ratio of the radius of the inner cylinder wall to the annular thickness, a Reynolds number based on the diameter of the sphere and the rate of rotation of the cylinders, and the density difference between the sphere and the liquid was also found. Methods for the prediction of migration phenomena as well as a correlation of the experimental measurements were presented. Dissert. Abstr.

N68-37741 Duke Univ., Durham, N. C.
VELOCITY DISTRIBUTION OF PARTICLES EVAPORATED FROM MOLTEN LEAD AND INDIUM
Candler Arthur Willis, Jr. (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-2751

Velocity distributions of particles emerging from the surface of pools of liquid lead and liquid indium are obtained by interposing a rotating disc mechanical velocity filter between the vapor source and a quartz crystal detector. The filter is operated at various pass bands and an intensity versus velocity curve is obtained. A method of determining the actual velocity distribution from the data is presented. A model of vaporization based on the assumption that the high energy particles in the liquid can be described by a Maxwellain distribution is presented. Evaporation rate measurements were made and from these rates it was possible to compute the height of the hill above the vapor phase level. The hill height required to explain the velocity spectra is in good agreement with that determined from evaporation rate measurements. Dissert. Abstr.

N68-37745# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
LOW-WAVENUMBER CONTENT OF THE SPECTRUM OF THE WALL PRESSURE UNDER A TURBULENT BOUNDARY LAYER Final Report, 31 Jul. 1966–31 Jul. 1967
K. L. Chandiramani and W. K. Blake 30 Jun. 1968 67 p 22 refs
(Contract Nonr-2321(00))
(BBN-1557; AD-672030)

The report deals with the low-wavenumber content of the wall-pressure spectrum under a turbulent boundary layer. A discussion is given of the importance of the low-wavenumber content for evaluating transducer attenuation. Comments are made on the lack of reliable experimental data regarding the low-wavenumber content. Calculations are presented to substantiate the above comments. Direct experimental measurements of the low-wavenumber content are reported. Author (TAB)

N68-37786 Maryland Univ., College Park.
ON THE FLOW OF NON-STEADY COMPRESSIBLE BOUNDARY LAYERS WITH VARIABLE TRANSPORT PROPERTIES
Stefan Schreier (Ph.D. Thesis) 1967 265 p
Available from Univ. Microfilms: HC $11.95/Microfilm $3.45 Order No. 68-3379

The unsteady, compressible boundary layers over a semi-infinite flat plate and over an accelerating body are investigated, taking into account the variation of $\rho\mu$ with h. The cases considered for the semi-infinite flat plate include constant acceleration, acceleration a polynomial of t, constant wall temperature, insulated wall, wall temperature varying in a given way with time, and wall temperature varying in a given way with time and distance from the leading edge. In all cases, the plate is assumed to start from rest. The equations are written with respect to a coordinate system fixed in the plate. The substitutions are made, and the equations are solved by use of the doubly infinite series expansions. The resulting series of ordinary differential equations are solved on a computer. Dissert. Abstr.

N68-37882# Naval Ship Research and Development Center, Washington, D. C. Applied Mathematics Lab.
THE SPECTRUM OF THE FINAL DECAY OF LOCALIZED DISTURBANCES IN A VISCOUS FLUID
Hans J. Lugt Jun. 1968 46 p 14 refs
(NSRDC-2785; AD-673533)

Based on previous work of Batchelor and Phillips it is shown that in an unbounded viscous fluid any decaying localized disturbance with a negligible nonlinear inertial force consists of a spectrum of dissipating spherical vortices. All these vortices can be derived from decaying multipoles. Such disturbances are characterized by a vorticity field which originates from a point source of vorticity and vanishes exponentially far away from its center. The result has been obtained by a Taylor-series expansion of the vorticity about the origin in a wave-number space. Vorticity fields which are produced in an extended region and over a finite period of time can be described by superposition. An example is given for decaying axisymmetric spherical discontinuity surfaces. Author (TAB)

N68-37883# Bettis Atomic Power Lab., Pittsburgh, Pa.
ANNULAR FLOW AIR-WATER MIXING TESTS
A. C. Peterson Jun. 1968 54 p 9 refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-727) CFSTI: HC $3.00/MF $0.65

Two phase eddy diffusivities of mass are measured in the wide direction of a 3.0 × 0.100 inch vertical duct, with upflow of both air and water, using a dye tracer in the water and a He tracer in the air. An experimental technique is used which divides the flow into nine transverse tracks, and the flows and tracer concentrations of each phase in each track are measured. The data are analyzed using the diffusion equation for a single phase applied to each phase separately. The two phase eddy diffusivities of mass are up to 40 times larger than those obtained during single phase flow. Author (NSA)

N68-37918# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
SOME MEASUREMENTS IN THE SELF PRESERVING JET
I. Wygnanski and H. Fielder Apr. 1968 63 p
(D1-82-0712; AD-672026)

The axisymmetric turbulent incompressible and isothermal jet was investigated by use of linearized constant temperature hot wire anemometers. It was established that the jet was truly self preserving some 70 diameters downstream of the nozzle and most of the measurements were made in excess of this distance. The quantities measured include mean velocity, turbulence stresses, intermittency, skewness and flatness factors, correlations, scales, low frequency spectra and convection velocity. The r.m.s. values of the various velocity fluctuations differ from those measured previously as a result of lack of self preservation and insufficient frequency range in the instrumentation of the previous investigations. It appears that Taylors hypothesis is not applicable to this flow, but the use of convection velocity of the appropriate scale for the transformation from temporal to spatial quantities appears appropriate. The energy balance was calculated from the various measured quantities and the result is quite different from the recent measurements of Sami (1967) which were obtained twenty diameters downstream from the nozzle. In light of these measurements some previous hypotheses about the turbulent structure and the transport phenomena are discussed. Some of the quantities were obtained by two or more different methods and their relative merits and accuracy are assessed. Author (TAB)

N68-37961# Aeronautical Research Council (Gt. Brit.)
A DIGITAL COMPUTER PROGRAM FOR THE THROUGH FLOW FLUID MECHANICS IN AN ARBITRARY TURBOMACHINE USING A MATRIX METHOD
H. Marsh 1968 34 p Supersedes NGTE-R282; ARC-28246
(ARC-R&M-3509; NGTE-R282; ARC-28246)

A detailed description is given of the development of a computer program for analysing the flow through axial, radial and mixed-flow turbomachines. The theory is based on the through-flow analysis given by C.-H. Wu and the equation for the stream function is solved by a matrix method. The theoretical predictions are compared with experiments reported by R. A. Jeffs for a low-speed axial-flow compressor and it is shown that the theory gives a good estimate for the axial velocity profile. Author (TAB)

N68-38013# Ohio State Univ., Research Foundation, Columbus.
A LINEARIZED ANALYSIS OF MASS-TRANSFER EFFECTS ON CONFINED LAMINAR VORTEX FLOWS
Odus R. Burggraf Wright-Patterson AFB, Ohio ARL Apr. 1968 45 p refs
(Contract AF 33(615)-1063)
(ARL-68-0071; AD-674612) CFSTI: HC $3.00/MF $0.65

A theoretical analysis of mass transfer effects on confined laminar vortex flows is presented, with emphasis on the structure of the flow at the limits of very large and very small rotational Reynolds number. For large Reynolds number, a linearized theory is formulated for a swirl chamber of arbitrary smooth configuration, within the limitation of axisymmetric flow, based on the boundary layer model introduced by Proudman. The method of solution is illustrated by applying it to special types of mass transfer in a spheroidal swirl chamber. The theory reveals that the mass is transferred from an annular injector ring to an axial exit nozzle partly by surface flow in the boundary layer and partly by helical flow through the body of the inviscid core. For mass transfer unsymmetric with respect to the equatorial plane, a viscous jet along the axis of symmetry completes the circuit. For small Reynolds number, the Stokes-flow theory is applied to the case of a spherical swirl chamber and exact solutions are obtained for the complete flow field for arbitrary mass-transfer distribution. Numerical results are obtained for an equatorial injector band with axial exit nozzle, and comparison is made with corresponding results for the high Reynolds number case. Author (TAB)

N68-38059*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LOW GRAVITY LIQUID-VAPOR INTERFACE SHAPES IN AXISYMMETRIC CONTAINERS AND A COMPUTER SOLUTION
Leon J. Hastings and Reginald Rutherford, III 7 Oct. 1968 100 p refs
(NASA-TM-X-53790) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A theoretical method for determining equilibrium interface configurations in axisymmetric containers of arbitrary shape was investigated. A single differential equation was derived from the principle of minimum surface and potential energy using the calculus of variations. This equation, in conjunction with boundary conditions dependent on container shape and contact angle, can be numerically solved for the desired surface profile using the Runge-Kutta iteration technique. The method imposes no significant limitations on contact angle or Bond number and is easily programmed for computer solutions. Representative theoretical results are presented concerning the influences of contact angle, Bond number, and container fill level on surface shapes. Also, theoretical results are compared with experimental data. Author

N68-38112 Aix-Marseilles Univ. (France). Inst. de Mechanique des Fluides de Marseille.
LAMINAR BOUNDARY LAYER AND DOWNSTREAM RELAXATIONAL VIBRATIONS OF TRAVELING SHOCK WAVES. PART 2, STUDY B [ETUDE B, 2EME PARTIE. COUCHE LIMITE LAMINAIRE ET RELAXATION DE VIBRATION A LAVAL D'UNE ONDE DE CHOC MOBILE]
R. Brun and J. P. Guibergia [1968] 70 prefs In FRENCH
(Contract DRME-67014)
CFSTI: $3.00

The influence of vibrational relaxation on the temperature and velocity profiles, on the thickness of the laminar boundary layer, and on the parietal heat flux is studied for the cases of incompressible and equilibrium flow of a traveling shock wave. A method is proposed for determining the temperature profiles of a nonequilibrium vibrational boundary layer; the method is based on conserving the equilibrium enthalpy profiles and is independent of the following relaxation parameters: product density and viscosity, specific heat, and relaxation time. Nitrogen and carbon dioxide were chosen as the test gases, because they possess very different vibrational energy percentages at ambient temperature. Experimental and calculated values of parietal heat flux are plotted. Transl. by B.P.

N68-38114# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CORRECTION OF THE EFFECT OF THE BOUNDARY LAYER ON THE FLOW IN NOZZLES WITH A BROKEN GENERATRIX [KORREKTIROUKA ULIYANIYA POGRANICHNOGO SLOYA NA TECHENIE V SOPLAKH S IZLOMOM OBRAZVYUSHCHEI]

L. V. Pchelkina and V. K. Solodkin 21 Sep. 1967 6 p Transl. into ENGLISH from Vychislitelnyi Tsentr. Sb. Rabot (USSR), no. 4, 1965 p 103–107

(FTD-HT-67-91; AD-674724)

The larger the Mach number for which a supersonic nozzle is designed, the smaller the characteristic Reynolds number and, consequently, the larger the region of flow occupied by the boundary layer. For given diameters of the exhaust nozzle cross section and given flow parameters, a reduction of the boundary layer may be achieved by a reduction in nozzle length. Nozzles with a broken generatrix or nozzles with an angle point are of minimum length. U. G. Pirumov et al. (Chislennyye metody v gazovoy dinamike. Sbornik rabot, VTs MGU, no. 2, 1963) presented earlier a method for the design of axisymmetric nozzles with an angle point in the presence of equilibrium physicochemical transformation. The correction of the shape discussed in the present paper is supposed to secure a constant Mach number equal to the exit value M sub O in viscous flow along the axis of the nozzle (starting with a certain point). Following the known procedure of the boundary layer theory, the corrected shape is obtained from the original one by the shift in the direction of the outward normal through a distance equal to the thickness of the boundary layer displacement. Results are calculated for the M sub O value of 10.

Author (TAB)

N68-38152# Hydronautics, Inc., Laurel, Md.

ON INTERNAL GRAVITY WAVES GENERATED BY SUBMERGED DISTURBANCES

K. K. Wong Aug. 1968 34 p refs

(Contract Nonr-3349(00))

(TR-117-13; AD-674372) CFSTI: HC $3.00/MF $0.65

The problem of gravity waves generated by a disturbance moving horizontally in a stratified fluid with a free surface has been considered recently by experiments and theory. The linear theory, which considered only the vertical component of the perturbation velocity, found internal waves only on the downstream side of the disturbance. The experiments, however, have disclosed the presence of upstream unattenuated waves (blocking). This report attempts to resolve this issue within the framework of a linearized theory incorporating the Boussinesq and Oseen approximations, and accounting for the blocking effects as essentially horizontal motions. The fluid is assumed unbounded with a constant Vaisala frequency, and the concept of group velocity is used to clarify the physical basis of the solution.

Author (TAB)

N68-38175# Aeronautical Research Council (Gt. Brit.).

THE STEADY LAMINAR INCOMPRESSIBLE BOUNDARY LAYER PROBLEM AS AN INTEGRAL EQUATION IN CROCCO VARIABLES INVESTIGATION OF THE SIMILARITY FLOWS

R. D. Mills 1968 49 p refs Supersedes ARC-28116

(ARC-R&M-3515; ARC-28116; AD-834125) HMSO: £1 1s

The steady flow incompressible laminar boundary-layer problem in two-dimentions is posed as an integral equation in Crocco variables in the most general case. Numerical investigations are then made of the similarity flows. A transformation is utilised which weakens the singularity at the outer edge of the boundary layer and thereby gives improved numerical results over those obtained from the untransformed equation. An extensive numerical comparison is made with Polhausen's exact analytical solution. Results are also presented in tabular and graphical form illustrating the approach of the boundary-layer characteristics Skin friction, displacement, momentum, energy thickness to their asymptotic values for strong suction for a very wide range of similarity flows. These are in complete agreement with the results obtained by other investigators, and form an extension to the cases previously considered. TAB

N68-38195# New York Univ., New York. Dept. of Meteorology and Oceanography.

THE FLOW BETWEEN TWO PLATES OF A FLUID CONTAINING RIGID STRUCTURES Preliminary Report

A. D. Kirwan, Jr. and Nathan Newman Aug. 1968 28 p refs

(Contract Nonr-285(57))

(TR-68-9; AD-674435) CFSTI: HC $3.00/MF $0.65

The flow between two plates of a fluid containing rigid structures is examined analytically. Profiles of the velocity and averaged vorticity of the structures for a wide range of cases are given. It is found that the velocity profiles can have convex portions near the boundaries and that they may resemble the box shaped profiles characteristic of high Reynolds number Navier-Stokes flow.

Author (TAB)

N68-38262# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

WAVE CONDITIONS OF A FLOW OF A THIN LAYER OF VISCOUS LIQUID UNDER THE EFFECT OF GRAVITATION [VOLNOVYE REZHIMY TECHENIYA TONKOGO SLOYA VYAZKOI ZHIDKOSTI POD DEISTVIEM SILY TYAZHESTI]

V. Ya. Shkadov 17 Jan. 1968 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR. Mekhan. Zhidkost i Gaza (USSR), No. 1, 1965 p 43–51

(FTD-MT-24-243-67; AD-624674) CFSTI: HC $3.00/MF $0.65

The problem of wave flow of a thin liquid film on a hard surface is solved analytically by using a method developed by the author and a system of equations comprising the Navier-Stokes and continuity equations. It is assumed that the surface of the liquid is free from any air friction effect. A film of liquid not bounded along the x-axis with time average thickness aO is considered and periodic solutions with respect to x are sought in the form of traveling waves. The solutions obtained here are applied to interpretation of experimental data obtained by P. L. Kapitsa and their accuracy is evaluated. Good agreement is obtained with respect to the values of average thickness and velocity of wave propagation, although the agreement is less good with respect to amplitudes. The comparison confirms sufficiently good accuracy of the solutions obtained here. TAB

N68-38271# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CAVITATION AND CERTAIN PROBLEMS IN HYDRODYNAMICS [KAVITATSIYA I NEKOTORYE ZADACHI GIDRODINAMIKI]

V. M. Ivchenko 20 Sep. 1967 15 p refs Transl. into ENGLISH from Akad. Nauk UkrSSR. Issled. Po Prikl. Gidrodinamike (Kiev), 1965 p 70–77

(FTD-HT-23-586-67; AD-674333) CFSTI: HC $3.00/MF $0.65

As a rule, cavitation occurs with the movement of a body in a drop form liquid at a high velocity (of the order of 30 meters/sec and higher). The article first discusses the reasons for cavitation and the conditions under which it appears. It is demonstrated that, among other factors, the appearance of cavitation depends on the turbulent fluctuations of the pressure in the boundary layer near the wall. It next discusses the effect of the roughness of a surface on the start of cavitation. Here it is pointed out that, in certain experiments, cavitation was observed to start at rarefaction coefficients considerably below the critical. The

remainder of the article is devoted to a general discussion of: cavitation erosion, cavitation noise, two-phase ...s and the hypothesis of an isothermally compressible fluid, developed cavitation flows and general mechanical theories, the theory of the action of vaned mechanisms and machines under supercavitation conditions, and the hydrodynamics of vapor-water mixtures. Author (TAB)

N68-38273# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MIXING PROCESSES IN A SYSTEM OF TWO PARALLEL JETS [PROTSESSY PEREMESHIVANIYA V SISTEME DVUKH PARALLELNYKH STRUY]
F. Frishman 9 Nov. 1967 9 p refs Transl. into ENGLISH from An. EstSSR Izv. Seri. Fiz. Mat. i Tekh. Nauk, v. 15, no. 2, 1966 p 207-210
(FTD-HT-23-989-67; AD-673925) CFSTI: HC $3.00/MF $0.65

An attempt was made to explain the possibility of using a method of Equivalent task of the theory of heat conduction for finding concentration fields in a binary system of two-dimensional jet flows with parallel axes. The results obtained are in satisfactory agreement with experimental findings. Author (TAB)

N68-38283# ARO, Inc., Arnold Air Force Station, Tenn.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF BOUNDARY LAYERS IN LOW DENSITY HYPERSONIC AXISYMMETRIC NOZZLES
David L. Whitfield Arnold Eng. Develop. Center Sep. 1968 92 p refs
(Contract F40600-69-C-0001)
(AEDC-TR-68-193; AD-674597) CFSTI: HC $3.00/MF $0.65

The viscous flow region in low density hypersonic axisymmetric nozzles was investigated both theoretically and experimentally. Nonsimilar solutions were obtained for the internal laminar boundary layer equations which include second-order transverse curvature terms. These solutions were obtained on a CDC 1604 digital computer. Four existing low density axisymmetric nozzles were considered. Numerical solutions were obtained for these nozzles using various plenum chamber conditions and wall temperature distributions. The plenum chamber conditions used in the numerical solutions for these nozzles produced a test section Mach number range of about 3.0 to 18.0 and a test section Reynolds number per foot range of about 1000 to 15,000. Some results of the numerical solutions are compared with experimental measurements of pitot pressure, relative heat flux, and nozzle wall heat transfer coefficients. In all comparisons the numerical solutions appear to be consistent with the experimental data. Author (TAB)

N68-38312# Politchnico di Torino (Italy). Istituto di Meccanica Applicata.
INCOMPRESSIBLE LAMINAR BOUNDARY LAYER PAST ELLIPTICAL BODIES
Gianni Jarre Feb. 1968 15 p refs
(Grant AF-EOAR-28-66)
(AFOSR-68-1744; SR-5; TN-41; AD-674291)

The skin-friction law, previously derived for two-dimensional bodies, is now extended to revolution bodies. These laws are applied to elliptical cylinders and to ellipsoids. The results are compared with those obtained by Pretsch through Pohlhausens method. Above all, the present method improves the setting of the separation point, occurring earlier on ellipsoids than on elliptical cylinders. Author (TAB)

N68-38357# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany).
ON THE PERTURBATION OF A SIMILARITY SOLUTION FOR THE TREATMENT OF THE PROPAGATION OF STRONG SHOCK WAVES [UPER DIE STORUNG EINER AEHNLICHKEITSLOESUNG ZUR BEHANDLING DER FORTPFLANZUNG STARKER STOEBE]
W. Gretler Aug. 1968 47 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-52; DVL-740) CFSTI: HC $3.00/MF $0.65

Starting from the similarity solutions for strong spherical or cylindrical shock waves converging towards a center, the shock front and the unsteady motion behind it is calculated by means of a perturbation theory. Within the frame of perturbation analysis, the solutions which are given in parameter representation with zero-order coordinates (similarity solution) serving as parameters satisfy the full Rankine-Hugoniot conditions. The behavior of the solutions in the vicinity of an exceptional point is investigated analytically and discussed. Author

N68-38372# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE EXAMPLE OF THE CALCULATION OF SUPERSONIC GAS FLOW NEAR THE AXIS OF SYMMETRY [OB ODNOM PRIMERE RASCHETA SVERKHZVUKOVOGO TECHENIYA GAZA VBLIZI OSI SIMMETRII]
U. G. Pirumov and V. N. Suvoroya 25 Sep. 1967 11 p refs Transl. into ENGLISH from Moscow Univ. Vychislitelnyi Tsentr. Sb. Rabot (USSR), no. 4, 1965 p 52-61
(FTD-HT-67-412; AD-674153) CFSTI: HC $3.00/MF $0.65

An investigation was made of calculating supersonic flow occurring during the exhausting of a gas at a constant velocity from an axisymmetric aperture. TAB

N68-38432# Maryland Univ., College Park.
RESEARCH ON FLUID DYNAMICS IN JAPAN
Shih-I Pai Wright-Patterson AFB, Ohio. ARL Mar. 1968 53 p refs
(Contract AF 33(615)-3968)
(ARL-68-0061; AD-674059)

The report contains information on organization of research and research programs in fluid dynamics in Japan. Author (TAB)

N68-38449# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
EFFECT OF SURFACE ROUGHNESS ON AXISYMMETRIC LAMINAR SEPARATED FLOWS AT M = 5.4
W. C. Schnell and J. J. Ginoux Jan. 1968 69 p refs
(Grant AF-EOAR-43-66)
(VKI-TN-41; SR-1; AD-674003)

The effect of controlled roughness was studied on a flared ogive cylinder at M = 5.3, with emphasis on three-dimensional perturbations at reattachment, by employing pitot pressure surveys and sublimation techniques. Cylindrical roughness elements of slightly less than the boundary layer thickness were used. Protuberances of this size were found not to contaminate the laminar reattachment compared to a model free of roughness. The results indicated that weak disturbances upstream of separation became amplified in the free shear layer and produced significant spanwise pitot pressure fluctuations at reattachment. Results of a systematic investigation of the effects of roughness height, diameter and spacing are presented. Author (TAB)

N68-38450# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF LOSS OF TOTAL PRESSURE IN DIFFUSER CHANNELS [K VOPROSU RASCHETA POTER POLNOGO DAVLENIYA V DIFFUZORNYKH KANALAKH]
A. Sh. Dorfman 29 Nov. 1967 9 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), v. 12, no. 6, 1966 p 29–31
(FTD-HT-23-1052-67; AD-674277) CFSTI: HC $3.00/MF $0.65

The article deals with the different determinations of equivalent angles of expansion used in the evaluation of the losses of total pressure in curvilinear diffuser channels. It is shown that diffusers should be considered equivalent which have identical degrees of widening. The length is determined by the ratio of the surface of the diffuser to the area of its output section. Author (TAB)

N68-38451# Politecnico di Torino (Italy). Istituto di Meccanica Applicata.
SHOCK WAVE PRECURSOR MEASUREMENTS. PART 1: ONE-DIMENSIONAL THEORY OF ELECTROSTATIC PROBES IN UNSTEADY CONDITIONS WITH ION GENERATION
Ario Romiti Oct. 1967 22 p refs
(Grant AF-EOAR-66-28)
(AFOSR-68-1747; SR-2; TN-38, Pt. 1; AD-674290) CFSTI: HC $3.00/MF $0.65

The requirement of high sensitivity gages for precursor measurements in weakly ionized gas ahead of shock waves in diaphragm-operated shock tubes has been met by establishing an electrostatic probe theory fit for the experimental conditions. Explicity expressions for ion number density, concentration and precursor source function have been found. Author (TAB)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-37453 Colorado Univ., Boulder.
THE IONIZED CONSTITUENTS IN THE 100 TO 300 KILOMETER REGION OF THE EARTH'S UPPER ATMOSPHERE
Richard Bryce Norton (Ph.D. Thesis) 1967 181 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-2660

A model of the upper atmosphere ion composition is constructed by combining the best available data for neutral composition, solar UV and X-ray flux, ionization cross sections and efficiencies, and molecular reaction rates. This model is compared with the ion and electron density profiles that have been obtained by rocket and satellite experiments as well as ground based radar experiments. The atomic nitrogen (N) and nitric oxide (NO) concentrations agree reasonably well with observations above 124 km but depart drastically at lower altitudes. Atomic nitrogen concentrations of the order of $10^7 cm^{-3}$ or greater are estimated for the E and F1 region. The model is found to agree quite well with the observed height profiles of ion composition and is used to compute the ion concentration at various heights as a function of time. Dissert. Abstr.

N68-37604*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
MEASUREMENT OF ELECTRIC FIELDS IN THE IONOSPHERE. VOLUME 1: SUMMARY TECHNICAL REPORT Final Report, Aug. 1966–Sep. 1967
Gerald Levy, Herbert Jacobs and Edgar Bendor Sep. 1967 74 p 34 refs
(Contract NAS8-20663)
(NASA-CR-98042; PCD-TR-67-9; FHR-3287-1) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A sensitive electric field meter which has a five order of magnitude dynamic range has been developed for use within the ionosphere and has been laboratory tested. The meter utilizes the technique of the deflection of an electron beam under the influence of the electric field to be measured. The deflection of the beam is monitored on a segmented target. Displacements as small as 10^{-5}mm are detected. The deflection signal is amplified and fed back to the deflection plates to continually null the virtual center of the beam. Two components of the electric field orthogonal to the beam direction are simultaneously measured. The output of the loop is synchronously detected and filtered. Thus a d.c. voltage level which is proportional to the electric field being measured is available for read-out. Ambient electric fields within the ionosphere have been measured to range from 10 millivolt/meter and less, up to 100 millivolt/meter and more. The design analysis included plasma sheath and wake effects of the meter components and nearby bodies, the modification of the ambient electric field and plasma properties due to the electron beam, and the attitude resolution requirements to determine the apparent electric field due to the $(\bar{v}\times\bar{B})$ of the spacecraft and magnetosphere which is inseparable from all electric field measurements. Author

N68-37628 California Univ., Los Angeles.
X-RAY AND EUV PHOTOMETRIC DETERMINATIONS OF THE LATITUDINAL AND TEMPORAL VARIATIONS OF THE TOTAL PARTICLE AND DIOXIDE MOLECULE DENSITY DISTRIBUTION IN THE REGION 70–150 KILOMETERS IN THE EARTH'S ATMOSPHERE
Alan John Grobecker (Ph.D. Thesis) 1967 494 p
Available from Univ. Microfilms: HC $22.30/Microfilm $6.30 Order No. 68-3259

On 21 February 1966, three experiments were rocket-launched: two at Eglin Gulf Test Range, Florida (30° 12'N 86° 42'W), and one at Churchill Research Range, Canada (58° 45'N 93° 00'W). The three experiments constitute an investigation of latitudinal and temporal variation of the O_2 and total-particle density in the terrestrial atmosphere between 70- and 150-km altitude. For each launch, data were obtained on absorption of solar radiation in the Schumann–Runge continuum, hydrogen Lyman alpha, and X-rays in the 44 to 60A and 0 to 20A bands. From these data, densities of total particles, O_2 molecules, and atomic oxygen are computed. Distribution of the density versus altitude is shown in each case. The two Florida launches made at about 0710 and 1357 CST provide a measure of diurnal variation of latitude 30 N. Little difference is seen in the heights of the turbopause: 119.5 and 118.5 km, respectively. The data of experiments launched about 1400 CST in latitudes 30 N and 60 N provide a measure of latitudinal variation. Dissert. Abstr.

N68-37692# Naval Oceanographic Office, Washington, D. C.
THE OCEAN ENGINEERING PROGRAM OF THE U.S. NAVY: ACCOMPLISHMENTS AND PROSPECTS
Sep. 1967 129 p
(AD-665974)

Navy capabilities in ocean engineering; developments in technology for undersea missions; developments in environmental prediction and oceanographic survey; ocean engineering and test facilities; ocean engineering and a new initiative deep ocean technology. TAB

N68-37720# Navy Dept., Washington, D. C.
THE RESULTS OF THE FIRST DECADE OF SOVIET ANTARCTIC RESEARCH. THE ELEVENTH SOVIET ANTARCTIC EXPEDITION [REZULTATY PERVOGO DESYATILETIYA SOVETSKIKH ISSLEDOVANIY ANTARKTIKI. ODINNADTSATAYA SOVETSKAYA ANTARKTICHESKAYA EKSPEDITSIYA]
V. G. Aver'yanov et al 15 Mar. 1968 7 p Transl. into ENGLISH from Inform. Bull. of the Soviet Antartic Expedition, no. 58, 1966 p 71–76
(NIC-2559; AD-667292)

The Leningrad polar explorers -- geographers, geologists, geophysicists, biologists, and climatologists -- met in a general assembly to discuss scientific research in Antarctic regions. Scientists attending the conference gave results of research in varied fields of science conducted by them during the Antarctic expeditions. Author (TAB)

N68-37757# Naval Oceanographic Office, Washington, D. C.
SALT CONTENT OF SEAWATER AND ICE [SOLEVOI SOSTAV MORSKOI VODY I LDA]
L. K. Blinov 1968 68 p refs Transl. into ENGLISH from Tr., Gos. Okeanogr. Inst. (USSR), v. 83, 1965 p 5–55
(NOO-TRANS-370; AD-670657)

The paper represents two chapters of an unfinished book Chemistry of the Sea. It discusses the salt content of ocean water, salinity and salt composition of sea ice in connection with the processes of transitional stages, and the formation of ice from seawater as a complex solution. The study is based on a large quantity of factual material and presents interesting and original conclusions. Author (TAB)

N68-37759# Army Electronics Labs., Fort Monmouth, N. J.
LONG-DISTANCE AIRBORNE GLACIAL SOUNDING
John W. Walker Sep. 1967 19 p 6 refs
(ECOM-2887; AD-664152)

Experiments during the summer of 1966 established the feasibility of using airborne 30 MHz vertical incidence radar for sounding the thickness of polar ice sheets over long-range traverses. Four flights across Greenland each averaging 8 hours of flight time and approximately 2400 km. in length were continuously sounded. An automated data acquisition system, employed for the first time, was primarily responsible for the increased long-range capability. The principal limitations have been attributed to problems associated with navigating the polar regions. Author (TAB)

N68-37787*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DATA ANALYSES IN CONNECTION WITH THE NATIONAL GEODETIC SATELLITE PROGRAM Quarterly Progress Report, 1 Apr.–30 Jun. 1968
C. A. Lundquist and R. W. Martin Sep. 1968 8 p 1 refs
(Grant NSR-09-015-018)
(NASA-CR-97354; QPR-13) CSCL 08E

The gravity field determination computer program was improved for the Standard Earth calculation to be performed later in 1968. Analytical extensions to the program include the capability for handling zonal harmonics up to degree 21 in place of 14 as in 1966, and more powerful air drag and solar radiation pressure theories. Other improvements include more refined techniques for treating doppler data and refinements in generalized data processing program. The bulk of the computational effort this quarter was devoted to orbit determinations for use in a new zonal harmonics determination. Fourteen of the 15 satellite observation files to be analyzed were completed with mean elements determined independently every 2 days. These files, consisting of some 123,000 Baker–Nunn observations covering intervals of up to 5 and 6 years, are displayed. Author

N68-37788# Port Moresby Geophysical Observatory (New Guinea).
PRELIMINARY EARTHQUAKE PHASES, 14–21 OCTOBER 1968
21 Oct. 1968 6 p
CFSTI: HC $3.00/MF $0.65

Data are tabulated on earthquake phases recorded at Port Moresby, Goroka, Lae, and Konedobu seismograph stations from 14 to 21 October 1968. Author

N68-37824*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
STRATOSPHERIC-MESOSPHERIC COUPLING DURING STRATOSPHERIC WARMINGS
Hans Volland and Guenter Warnecke Sep. 1968 52 p 27 refs
(NASA-TM-X-63376; X-621-68-369) CFSTI: HC $3.00/MF $0.65
CSCL 04B

The thermal disturbance observed during the sudden stratospheric warming in January 1963 showed a wave-like behavior. The wave characteristics of this event were consistent with the propagation and attenuation of downward propagating turbulent heat conduction waves. Full wave calculations indicate that the stratosphere behaves like a selective filter with respect to atmospheric waves. Waves can propagate northward only under the condition of a resultant southerly wind of about 5 m sec^{-1}. Upward propagating waves in the mesosphere are attenuated in such a manner that their relative amplitude generally does not increase with altitude. These considerations, in conjunction with the physical interpretation of observations of sudden stratospheric warmings and simultaneous short period winter anomalies in the ionospheric D-region, lead to the suggestion of a common source, in form of a sudden initial heat impulse, of both phenomena. An upper limit for the generation of the initial heat impulse was placed at 50 km on the basis of observed wave characteristics and of static stability requirements in the polar winter mesosphere. The common source seems to be located at or a little below the stratopause. Author

N68-37827# Norwegian Defence Research Establishment, Kjeller.
THE IONOSPHERE
Bjorn Landmark *In* AGARD Radio Wave Propagation Jul. 1968 48 p 37 p refs (See N68-37825 24-07)

Production of the ionosphere, structure of the quiet ionosphere, regular and irregular variations of the ionosphere, and some properties of the polar ionosphere are discussed. Temperature, pressure, collisions and collision frequency, and composition of the neutral atmosphere are described. Production of ionization is considered in terms of the mechanisms of ionization and production by solar radiation; and the Chapman production function and its derivation are reviewed for the production of an ionospheric layer. Chapman layer and the constituents of the D, E, and F regions are described; with attention given to the recombination process. Other topics discussed include anomalies in the ionospheric F region, the sporadic E region, spread F and ionospheric irregularities, solar flares, and magnetic storms. The high latitude particles, polar cap and auroral absorption, and high latitude sporadic E are considered for the polar ionosphere. M.W.R.

N68-37853# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
AERONOMY RESEARCH Progress Report, Jul. 1967–1 Apr. 1968
R. J. Hoch Jun. 1968 49 p refs
(Contract AT(45-1)-1830)
(BNWL-795) CFSTI: HC $3.00/MF $0.65

Among the main accomplishments of the 9-month period were: completion of the second meridian spectrograph and establishment of an observing program at the northern station in Banff, Alberta, Canada; completion of the laboratory and office

facilities at the observatory on Rattlesnake Mountain; and acquisition and installation of the photometric apparatus at Boulder, Colorado. Work is proceeding on a tentative explanation of the stable auroral red arcs in terms of world-side motions of the ionosphere, and progress has been made on the design and procurement of what will be a very advanced photometric scanning system. NSA

N68-37874*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL RADIANCE SPECTRA 8 TO 16 MICRONS. NO. 1. WHITE SANDS AND THE MALPAIS (LAVA) C-47 AIRCRAFT
W. A. Hovis, Jr. Aug. 1968 122 p 1 ref
(NASA-TM-X-63375; X-622-68-337) CFSTI: HC $3.00/MF $0.65 CSCL 08G

A filter wedge spectrometer was used over desert terrain near El Paso, Texas to record the spectral signature of earth spectral radiant emittance from 8 to 16 microns. The spectrometer is equipped with a temperature controlled thermistor bolometer detector and has a resolving power $\lambda/\Delta\lambda = 50$ from 8 to 13.7 microns and $\lambda/\Delta\lambda = 100$ from 13.7 to 16 microns. A small break in the spectra denotes the change from the lower to higher resolving power segments. A complete scan was accomplished every 30 seconds. The spectrometer was mounted in the bottom of a C-47 type aircraft. NASA 636, from the Lewis Research Center. Author

N68-37940# Aeronautical Chart and Information Center, St. Louis, Mo.
CARTOGRAPHIC VIEWER UTILIZATION ANALYSIS BY SIMULATION
Froman Hulbert Aug. 1968 33 p *Its* ACIC Tech. Paper No. 22
(AD-674759)

Cartographers at the management level have contended that mere utilization percentages are not the sole criterion upon which equipment acquisition decisions should be based. It has been suggested that the most economic equipment complements might depend, at least in part, upon the extent to which jobs are delayed or deferred where equipment facilities are unduly restricted. In this study, the waiting line or queue of users or deferred jobs engendered by the relative limitation of available equipment facilities was analyzed. The paper describes the development of the viewer utilization model and, then, the results of the simulations required to ascertain reactions and costs where constant workloads were serviced with changing equipment configurations. The least cost equipment complement is rigorously determined using the simulation technique, maximum verisimilitude, and practical cost assumptions. The paper also demonstrates that the simulation technique, using the IBM developed simulator system GPSS-III, need not be a crude imitation but, with careful analysis, can result in a fairly precise and finely sculpted modeling of a real world situation. Author (TAB)

N68-37988# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA, JANUARY 1967
Jan. 1967 79 p
(RRC-A140) CFSTI: HC $3.00/MF $0.65

Ionospheric data recorded at 8 vertical incidence stations in India during January 1967 are presented in 70 tables. M.W.R.

N68-37970# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF THE CHARACTER OF GROUND SURFACE ON THE POLARIZATION OF SCATTERED LUMINOSITY OF THE SKY [VLIYANIE SVOISTV PODSTILAYUSCHCHEI POVERKHNOSTI NA POLYARIZATSIYU RASSEIANNOGO SVETA NEBA]
P. N. Boiko Nov. 1967 22 p refs Transl. into ENGLISH from Tr. Astrofiz. Inst., Akad. Nauk Kazakhskoi SSR (Alma Ata), v. 3, 1962 p 149–162
(FTD-MT-24-279-67; AD-674321)

Results are presented on the degree of polarization and the orientation of the polarization plane, as measured by a spectrophotometer with automatic recording. The dependence of polarization on snow cover, wavelength, etc., is considered. TAB

N68-38021# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
HELICOPTERS ON RECONNAISSANCE AND IN ERECTION OF SIGNALS IN SANDY REGIONS [VERTOLET NA REKOGNOSTSIROVKE I POSTROIKE ZNAKOV V PESCHANYKH RAI ONAKH]
V. L. Gutkin Jul. 1968 10 p Transl. into ENGLISH from Geodes. i Kartograf. (Moscow), no. 8, 1966 p 16–19
(ACIC-TC-1444; AD-674621) CFSTI: HC $3.00/MF $0.65

The paper discusses the use of helicopters to accomplish topographic-geodetic work in a sandy, nearly impenetrable region. The work was accomplished by one crew of 17 man and a rented helicopter. By calculation, the reconnaissance and erection of one point with the aid of a helicopter used approximately 280% less time than the same project using automobiles, and the budget economized by 200%. The use of a helicopter increases quality, secures the absence of blind spots and insures the prompt registering of data. One may conclude that the use of helicopters in the reconnaissance and erection of geodesic signals in remote regions is advisable, in spite of some rise in the cost of work as a result of the high cost of renting a helicopter. Author (TAB)

N68-38035# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 189
1 Oct. 1968 149 p refs Transl. into ENGLISH from a RUSSIAN publ.
(JPRS-46568) CFSTI: HC $3.00/MF $0.65

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1. ASTRONOMY p 1–16 ref (See N68-38036 24-30)
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4. TERRESTRIAL GEOPHYSICS p 58–98 refs (See N68-38039 24-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 99–130 refs (See N68-38040 24-13)

N68-38038# Joint Publications Research Service, Washington, D. C.
OCEANOGRAPHY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 189 1 Oct. 1968 p 52–57 refs (See N68-38035 24-13)

News items from the Soviet-bloc open literature on oceanography deal with a book on wave motions and origins, scientific research vessels and underwater laboratories, and an automatic underwater polarimeter and other instruments for measuring sea and wave parameters. An abstract is presented for an article dealing with geostrophic currents and equatorial circulation. M.W.R.

N68-38039# Joint Publications Research Service, Washington, D. C.
TERRESTRIAL GEOPHYSICS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 189 1 Oct. 1968 p 58-98 refs (See N68-38035 24-13)

Soviet-bloc news articles are presented along with abstracts of scientific articles in the field of terrestrial geophysics. News items cover some technical meetings as well as drilling of deep wells, earth tremor recordings, deformations of rocks at high temperatures and pressures, and the fundamental geodetic nets of the U.S.S.R. Earthquakes and other movements are considered in the abstracts; as are tidal measurements, magnetic field anomalies, and crustal thickness and chemical composition. Problems in forecasting earthquakes, various seismological instruments, and other meteorological studies are reported. M.W.R.

N68-38040# Joint Publications Research Service, Washington, D. C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 189 1 Oct. 1968 p 99-130 refs (See N68-38035 24-13)

Upper atmosphere and space research activities are discussed in new items and abstracts of scientific articles from Soviet-bloc literature. The news noted covers such subjects as Cosmos launches, an "intersputnik" communications system, and an encyclopedia on cosmonautics. Abstracts deal with lunar surface composition, cosmic ray intensities, ionospheric inhomogeneities, and solar activity affects. The magnetic field of Venus, ultraviolet absorption in the Jovian spectrum, surface polarization and absorption in CH_4 band of Jupiter and Saturn, noctilucent cloud emission, and other aspects of planetary atmospheres. Other topics are satellite orbits, F-2 ionization layer, ionospheric properties, and radio emission of extensive air showers. M.W.R.

N68-38052# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HYDRODYNAMIC SCHEME FOR FORECASTING OSCILLATIONS OF THE TROPOPAUSE [GIDRODINAMICHESKAYA SKHEMA PROGNOZA KOLEBANII TROPOPARZY]
V. M. Kadyshnikov 5 Jan. 1968 19 p refs Transl. into ENGLISH from Tr. Mirovoi Meteorl. Tsentr (Moscow), no. 14, 1966 p 59-70
(FTD-MT-24-373-67; AD-674707) CFSTI: HC $.300/MF $0.65

The author presents an example of precalculating the position of the tropopause by means of an equation in which the tropopause is regarded as a substantial surface. On this basis a closed system of prognostic relations is constructed which includes a calculation of the complex of meteorological elements characterizing the tropopause. By using the formula together with an ordinary prognostic scheme it is possible to determine not only the height of the tropopause but also such meteorological functions as temperature and wind in the tropopause. Using two other equations derived in the study the author constructs a closed system of prognostic relations relative to the geopotential wind speed, vertical currents, and temperatures of selected levels, included in the tropopause, and also the pressure in the tropopause. Author (TAB)

N68-38053*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ACCURACY OF WIND DATA OBTAINED BY TRACKING A JIMSPHERE WIND SENSOR SIMULTANEOUSLY WITH TWO FPS-16 RADARS
Michael Susko and William W. Vaughan 5 Jul. 1968 46 p refs
(NASA-TM-X-53752) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Thirty dual FPS-16 radar tracks of Jimsphere wind sensors were obtained from Cape Kennedy, Florida; Green River, Utah; and Pt. Mugu, California. The RMS values over two-kilometer layers for wind speed differences, based on wind speeds computed over 50-meter intervals, were calculated for various elevation and azimuth angles and slant ranges. The evaluation was based on data acquired during normal range operations of the FPS-16 radar/Jimsphere system. Author

N68-38055# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ANALYSIS OF EXPENDITURE OF LABOR AND FINANCE IN TOPOGRAPHIC SURVEYING AT SCALE 1:25,000 IN MOUNTAIN REGIONS [ANALIZ ZATRAT TURDA I DENEZHYKH SREDSTVPRI TOPOGRAFICHESKOI SEMKE V MASSHTABE 1:25,000 V GORNYKH RAIONAKH]
V. A. Kargashina, V. S. Kirillova, and A. I. Naumova Aug. 1968 13 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 12, 1965 p 39-44
(ACIC-TC-1449; AD-674624)

The article indicates the change in expenditures of labor and finance in topographic surveying of mountain regions at a scale of 1:25,000 depending upon the type of technology employed for the work. The calculations are completed by the Department of Economics of TsNIIGAiK (Central Scientific Research Institute of Geodesy, Aerial Surveying and Cartography) for four technological schemes - in 1956, 1960, 1961 and 1964 - on two technical projects, comprising survey sectors: I-with an area of 16,793 sq. km., and II-with an area of 16,574 sq. km. Each sector includes 224 trapezoids at a scale of 1:25,000. The regions of work are situated in an uncontoured, mountain-taiga location, where movement is possible only by pack animals. The elevation difference over the average surface of surveying sectors comprises plus or minus 350.800 meters. The work season lasts five months. Author (TAB)

N68-38068# Allied Research Associates, Inc., Concord, Mass.
RELATION OF AEROSOLS TO ATMOSPHERIC FEATURES Final Report, 1 May 1967-15 Sep. 1968
David T. Chang and Raymond Wexler 15 Sep. 1968 29 p refs
(Contract F19628-67-C-0287)
(ARA-9G46-F; AFCRL-68-0360; AD-674629)

Relationships between aerosol attenuation coefficient profiles at White Sands, New Mexico, and atmospheric features were investigated. The dependence of lower stratospheric aerosol content on air mass characteristics and the correlation between the height of the lower stratospheric aerosol layer and the height of the tropical tropopause suggests a tropical source for these aerosols. Seasonal variations in aerosol content of the surface layer were found to reflect seasonal changes in convective activity in this layer. Author (TAB)

N68-38075# Princeton Univ., N. J. Geology Dept.
DIFFRACTION OF P BY THE CORE: A STUDY OF LONG-PERIOD AMPLITUDES NEAR THE EDGE OF THE SHADOW Semiannual Technical Summary Report
Robert A. Phinney and Lawrence M. Cathles 30 Jun. 1968 69 p refs
(Contract AF 49(638)-1243; ARPA Order 292)
(AD-674606) CFSTI: HC $3.00/MF $0.65

Theoretical expressions for the amplitude of P-waves in the neighborhood of the core shadow boundary have been formulated and evaluated by computer. Comparison with 2.5 second data of Sacks confirms his determination of the shadow position at 96.5 degrees. A square root frequency scaling law is found for the high frequency diffraction pattern, and permits use of the Fresnel integral function at short periods. Long-period amplitude data for three paths have been spectrum analyzed and compared against the theoretical amplitude dropoff going into the shadow. The agreement is about as good as the data will permit, and no indication is found at these periods of a low-amplitude defocused region at 90 degrees to 96 degrees, after diffraction has been accounted for. Author (TAB)

N68-38122# Physical Studies, Inc., Dayton, Ohio.
INTERPRETATION OF OV1-5 RADIOMETRIC OBSERVATIONS Final Report, 4 Jul. 1967–4 Jul. 1968
R. G. Breene, Jr., J. S. Swant, and L. P. Marcotte 4 Jul. 1968 187 p refs
(Contract F19628-67-C-0354)
(PSI-68-14; AFCRL-68-0379; AD-674767) CFSTI: HC $3.00/MF $0.65

Programs for the computation of Mie scattering functions have been written and run for ice and water clouds for a number of droplet size distributions in the 1.3 to 2.7 micrometer region. Methods for matrix element calculation are developed and applied to carbon dioxide, nitrous oxide and methane. Programs for emissivity calculation have been written and applied to such calculations for carbon dioxide and nitrous oxide. Programs for eigenvector and eigenvalue calculations have been written and applied to N2O. The results of these various calculations have been applied to certain OV1-5 spectrometer observations. Author (TAB)

N68-38150# American Science and Engineering, Inc., Cambridge, Mass.
THE FLUORESCENCE OF AIR AND NITROGEN EXCITED BY ENERGETIC ELECTRONS Final Report, 12 Mar. 1964–11 Feb. 1967
Robert R. O'Neil and Gilbert Davidson 1 Jan. 1968 150 p refs
(Contract AF 19(628)-4080)
(ASE-1602; AFCRL-67-0277; AD-673995) CFSTI: HC $3.00/MF $0.65

The optical radiation from air and nitrogen bombarded by energetic (kev) electrons was measured over a wide range of gas pressures. Absolute fluorescent efficiencies of spectra from 3,200 to 11,000A are presented for air and nitrogen at both 22 Torr excited by 10 kev electrons and 600 Torr excited by 50 kev electrons. At lower pressures, absolute intensity measurements have been made in the form of electron excitation cross sections for the first negative and Meinel bands of N2(+). The radiative lifetimes of the Meinel bands are also given. The pressure dependence of the first and second positive systems of N2 and the first negative and Meinel systems of N2(+) was analyzed. With the exception of the Meinel bands, the Stern-Volmer collisional quenching mechanism accurately describes the pressure dependence of these systems in nitrogen and air. Based on the Stern-Volmer analysis, the absolute intensity of the electron induced fluorescence is determined for various transitions of these four band systems for any pressure of air or nitrogen. Author (TAB)

N68-38168# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
NECESSARY DENSITY OF GRAVIMETRIC STATIONS ON FIRST AND SECOND ORDER LEVEL LINES IN MOUNTAINOUS REGIONS [O NEOBKHODIMOI CHASTOTE GRAVIMETRICHESKIKH PUNKTOV PO LINIYAM NIVELIROVANIYA 1–2 KLASSA V GORNYKH RAIONAKH]
G. D. Safonov Aug. 1968 8 p refs Transl. into ENGLISH from Geod. i Kartografiya (USSR), No. 6, 1967 p 15–17
(ACIC-TC-1471; AD-674625)

In the article an attempt is made to obtain a criterion for the necessary frequency of gravimetric stations to be determined along leveling lines in mountain regions. Author (TAB)

N68-38173*# Volt Technical Corp., Washington, D. C.
MAGNETIC FIELD STRUCTURE INSIDE THE MAGNETOSPHERE IN THE RECOVERY PHASE OF A MAGNETIC STORM
O. A. Molchanov Greenbelt, Md. NASA. Goddard Space Flight Center 27 Oct. 1968 8 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 5, 1968 p 868–873
(Contract NAS5-12487)
(NASA-CR-97372; ST-GM-PF-10766) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Herewith presented is a method of computation of geomagnetic field taking into account the external sources. The results are brought forth of field computation during the recovery phase of a magnetic storm at specific assumptions about parameters of perturbing currents. Author

N68-38238# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
SMOOTHING EFFECT OF THE TURBULENCE TERM IN OBJECTIVE ANALYSIS AND NUMERICAL PREDICTION
Chen-Chao Koo Bedford, Mass. AFCRL May 1968 11 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 28, no. 4, 1957 p 319–322
(Contracts F19628-68-C-0251; AF 19(628)-5073)
(EMM-67-166; AFCRL-68-0289; AFCRL-TRANS-5; AD-674480)

The elimination of small-scale perturbations from observed or predicted height fields forms one of the difficult steps in the numerical prediction of the upper-air flow patterns. Several different methods are compared, and a new method introduced whereby the desired smoothing may be achieved by introducing the turbulence term without requiring the preparation of separate smoothing programs. The inclusion of the turbulence term is particularly effective in filtering small-scale perturbations. Author (TAB)

N68-38245# Hydronautics, Inc., Laurel, Md.
FROUDE NUMBER SCALING OF WIND-STRESS COEFFICIENTS: A CORRELATION FOR WIND STRESSES DETERMINED AT ALL FETCHES
Jin Wu May 1968 24 p refs
(Contract Nonr-3688(00))
(TR-231-23; AD-674373) CFSTI: HC $3.00/MF $0.65

Following the verification of the logarithmic nature of the wind profile and the establishment of a nondimensional expression relating the shear velocity and surface roughness, a Froude number is proposed for scaling the wind-stress at the air-water interface. A correlation curve for wind stresses determined at all fetches is presented and is shown to correlate successfully the available data compiled from 42 independent investigations consisting of 12 laboratory studies and 30 oceanic observations. Author (TAB)

N68-38260# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUESTION OF CALCULATING THE VERTICAL WIND PROFILE IN THE BOUNDARY LAYER OF THE ATMOSPHERE [V VOPROSU O RASCHETE VERTIKALNOGO PROFILYA VETRA V POGRANICHNOM SLOE ATMOSFERY]
L. A. Klyuchnikova et al Nov. 1967 34 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 167, 1965 p 3–28
(FTD-HT-23-804-67; AD-674670) CFSTI: HC $3.00/MF $0.65

This paper is a further development of the theoretical model for the structure of the boundary layer of the atmosphere in stationary conditions as a function of external parameters. A mathematical model is proposed for the coefficient of turbulence and a system of equations is given for determining the vertical profiles of meteorological elements of the boundary layer under stationary conditions based on external parameters. This system of equations account for motion, heat transfer in the soil and in the atmosphere and humidity transfer in the atmosphere. The initial and boundary conditions for the problem are stated and a general

solution is given. Formulas are derived for calculating the vertical wind profile in the boundary layer of the atmosphere and a computational scheme is proposed for determining the various parameters appearing in these formulas. Examples are given illustrating the effect of the coefficient of turbulence on the structure of the boundary layer of the atmosphere. Author (TAB)

N68-38276# Stanford Research Inst., Menlo Park, Calif. Poulter Lab. for High Pressure Research.
THE EQUATION OF STATE OF ICE AND COMPOSITE FROZEN SOIL MATERIAL
Gordon D. Anderson Hanover, N. H. Cold Reg. Res. and Eng. Lab. Jun. 1968 61 p refs
(Contract DAAG23-67-0011; ARPA Order 968)
(CRREL-RR-257; AD-674248) CFSTI: HC $3.00/MF $0.65

To compute shock wave propagation in frozen soil-water mixtures it is necessary to know a constitutive relation or an equation of state of the medium under consideration. Shock wave techniques provide a powerful tool for the investigation of equations of state at very high stress levels. The stress-volume behavior of frozen soil-water mixtures in the range from 60 to 500 kbar was investigated. Hugoniot data were obtained for Ottawa banding sand (pure quartz sand) and West Lebanon (New Hampshire) glacial till of varying degrees of saturation and for polycrystalline and monocrystalline ice (c-axis oriented in the direction of shock propagation). Release cross curve data were obtained for dry and saturated Ottawa banding sand and for polycrystalline ice. All materials were at an initial temperature of -10C. In all experiments plane one-dimensional shock waves were used. The Hugoniots and release curves for the soil materials show evidence of a quartz-stishovite phase transition at about 300 kbar. The Hugoniots of single and polycrystalline ice do not differ significantly over the stress range studied - 30 kbar to 300 kbar. Author (TAB)

N68-38285# Northwestern Univ., Evanston, Ill. Dept. of Geology.
LEAST-SQUARES SURFACE FITTING WITH DISCONTINUOUS FUNCTIONS
William R. James Aug. 1968 56 p refs
(Contract Nonr-1228(36))
(TR-8; AD-674867) CFSTI: HC $3.00/MF $0.65

Surfaces with abrupt discontinuities can be described by using discontinuous two dimensional polynomials. Simultaneous least squares solutions can be found which estimate parameters that describe both the discontinuity and the polynomial coefficients. Two models for the common geological example of a faulted structural terrain are treated in detail. In the first the fault plane is vertical, with vertical displacement only. In the second model, both vertical and lateral translation are provided for. The first model is applied to the structural surface of the Dundee Limestone (Devonian) in Central Michigan. Other models for discontinuous surface fitting and other cases in the earth sciences where such models might be useful are briefly mentioned. A computer program for finding the least squares estimates of the fault parameters and the polynomial coefficients is included in an Appendix to this report. Author (TAB)

N68-38295# Air Force Cambridge Research Labs., Bedford, Mass.
EMPIRICAL DETERMINATION OF SCATTERED LIGHT TRANSPORT THROUGH THE LOWER ATMOSPHERE
George F. Riley May 1968 22 p refs *Its* Environ. Res. Papers No. 287
(AFCRL-68-0256; AD-673999) CFSTI: HC $3.00/MF $0.65

The transmissivity of the lower atmosphere for thermal radiation from an isotropic source to a flat receiver was obtained as a function of the distance of the receiver from the source and various meteorological conditions. The results of this investigation are based on data taken over ranges from 0.2 to 25 km with values of sigma R between 0.02 and 40. Author (TAB)

N68-38309# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
CERTAIN GEOLOGICAL AND GEOPHYSICAL FACTS AND THEIR INTERPRETATION IN RELATION TO THE EARTH'S CRUSTAL COMPOSITION AND STRUCTURE [NEKOTORYE GEOLOGICHESKIE I GEOFIZICHESKIE FAKTY I IKH INTERPRETATSIYA V OTNOSHENII SOSTAVA I STROENIYA ZEMNOI KORY]
G. D. Afanasev Jul. 1968 35 p Transl. from Akad. Nauk SSSR, Izv. Ser. Geol., No. 5, 1967 p 3–18
(ACIC-TC-1409; AD-674620) CFSTI: HC $3.00/MF $0.65

The author of the present article has made repeated critical analysis of the geological, geophysical and geochemical arguments on which the separation and identification of the two types of the earths crust from the mantle along the Moho surface is based. The present article supplements the conclusions stated in 1966 by the author that the evidence on the velocities of elastic waves in the profile of the upper shell, and the data on the gravity values in different sectors of the earths surface constitute the principal geophysical information on the deep-seated structure of the earths crust and mantle. An analysis is made of the way this information can lead to the determination of the layers in geophysical profile and of the petrographic composition of these layers. No sufficiently reliable experimental basis exists for the interpretation of geophysical data with deductions on petrographic composition of the separate shells of the earth. Author (TAB)

N68-38358# Woods Hole Oceanographic Institution, Mass.
PROJECT SEASPIDER: THE DESIGN, ASSEMBLY, CONSTRUCTION AND SEA TRIALS OF A TRI-MOORED BUOYANT STRUCTURE WITH NEUTRALLY BUOYANT LEGS TO PROVIDE A NEAR-MOTIONLESS INSTRUMENT BASE FOR OCEANOGRAPHIC RESEARCH
G. H. Savage and J. B. Hersey Jun. 1968 142 p refs
(Contract Nonr-4029(00))
(WHOI-REF-68-42; AD-673956)

The design concept and a summary of the motion analysis of the mathematical model of a tri-moored buoyant structure are presented. The need to adapt the structural design to the anticipated oceanographic environment in order to obtain a near-motionless system is discussed. Critical components of the total system are discussed, and experience with these components during the sea trials are recorded. Sea trials of the system conducted on the Blake Plateau in 2600 feet of water during July and August of 1965 are reviewed and the results using the system as a base for acoustic, temperature and current measurements are presented and discussed. Author (TAB)

N68-38362# Newcastle Univ. (Australia). Dept. of Physics.
PROPAGATION OF PC1 GEOMAGNETIC MICROPULSATIONS IN THE MAGNETOSPHERE AND THE IONOSPHERE Final Report
C. D. Ellyett, B. J. Fraser, F. T. Bagnall, R. N. Manchester, and P. W. McNabb Apr. 1968 157 p refs
(Grant Nonr(G)-00047-66)
(AD-673991)

The report details original equipment for continuously recording Pc1 geomagnetic micropulsations on magnetic tape with timing accuracy of less than 0.1 second. Analysis of the records is carried out by using both frequency-time and amplitude-time techniques. An extensive study of temporal variations in Pc1 in relation to propagation in the magnetosphere is detailed. Signals are generated in the lambda = 4.5 - 9.5 region of the magnetosphere and show diurnal and geomagnetic disturbance variations. The theoretical problem of north-south propagation of Pc1 signals in an ionospheric duct is treated. Comparison with experimental results show that wave group velocities in the duct vary from 400 to 800 km/sec, depending on the electron concentration in the duct and hence local time. Author (TAB)

N68-38376# Argonne National Lab., Ill. Radiological Physics Div.

THE VALIDITY OF CURRENTLY POPULAR PLUME RISE FORMULAS

James E. Carson and H. Moses *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 1–20 (See N68-38375 24-20)

The ground-level concentrations of pollutants downwind of a tall chimney decrease as the effective height of the stack increases. The effective height of the stack is the actual height plus the rise of the plume centerline due to momentum and buoyancy of the effluent. Over twenty plume rise formulas have been proposed, but none is widely accepted due in part to a lack of sufficient plume rise data for testing. 711 plume rise observations are used to test the ability of fifteen published formulas to predict plume rise. The plume rise data were obtained from stacks whose heat emission rate varied over four orders of magnitude. Author (NSA)

N68-38377# Waterloo Univ. (Ontario).

ON THE PROBLEM OF THE EFFECTIVE CHIMNEY HEIGHT

G. T. Csanady *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 22–36 (See N68-38375 24-20)

A derivation of an Effective Chimney Height (ECH) expression is presented for assessing the effects of buoyancy on the dispersal of effluents. The ECH is defined as the physical height of the smoke plume above the point of maximum ground level concentration. Extensive use is made of recently consolidated experimental evidence regarding the behavior of chimney plumes. Major atmospheric parameters considered include wind speed, gustiness, and stability. C.T.C.

N68-38378# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

SITE EVALUATION USING MEASURED METEOROLOGY DATA

R. E. Cooper and B. C. Rusche *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 41–50 (See N68-38375 24-20)

(Contract AT(07-2)-1)

A key factor in reactor site evaluation is the frequency of occurrence of various dispersion conditions and this relationship to potential off-site doses following a reactor accident. Detailed measurements of the wind speed, wind direction, and temperature at heights up to 1200 ft at the Savannah River Plant form the basis for a comprehensive analysis of the frequency of occurrence of potential off-site doses. A complete set of data was taken about every five minutes, and 107,000 sets (about one year of data) were analyzed. The meteorology data were converted to ordinary dispersion parameters through correlating equations. The results are expressed on curves in dose per unit release of activity vs distance from the reactor with probability of occurrence as a parameter. Separate sets of curves were calculated for releases of noble gas and of halogens and at release heights of 200 ft (a nominal stack height) and of 850 ft (about the height of the tallest power plant stacks). Additional curves were developed to show dose as a function of direction and probability of occurrence. Author

N68-38383# Battelle-Northwest, Richland, Wash. Atmospheric Sciences Section.

ON THE VARIATION OF CONCENTRATION IN PLUMES AND BUILDING WAKES

W. T. Hinds *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 105–131 (See N68-38375 24-20)

A short series of experiments to define the effect of wake flow on the variance of concentration is described. The time history of concentration at a point in building wakes from ground level sources was found to differ little from that observed in a plume from a point source. An approximate power law dependence of peak to mean ratios on averaging interval was observed in both wakes and unobstructed plumes, but ground level sources in wake flow yielded peak to mean ratios comparable to those observed from unobstructed elevated sources. Thus, it is surmised that elevated releases into wake flow probably will yield greater peak to mean ratios than unobstructed elevated sources. Author

N68-38428# Technical Operations Research, Burlington, Mass.

PHOTO-OPTICAL MEASUREMENTS ON HIGH-ALTITUDE BARIUM RELEASES Final Report, 1 Jul. 1967–31 May 1968

Irving L. Kofsky and Christian A. Trowbridge 28 Jun. 1968 38 p refs

(Contract AF 19(628)-5977)

(TO-B-68-41; AFCRL-68-0358; AD-674609)

Radiometrically calibrated photographs of the growth of neutral and ionized species resulting from the explosive release of barium at latitudes between 156 and 226 km were taken, reduced, and analyzed. Inventories of ions and atoms were calculated from the integrated spectral surface brightnesses of the sunlight scattering from the particles, and the data prepared for measurement of the transverse and longitudinal (to the magnetic field) diffusion coefficients of the ions. The phenomena accompanying exposure releases of barium at speeds comparable to the escape velocity have been considered theoretically; it was found that measurable numbers of ions will become trapped in the geomagnetic field. Other program tasks included microphotometric analysis of photographs of faint shocks, calibration of camera controls and interframe timing, development of a digital computer program for calculating horizontal wind shears, and setup and operation of photometric equipment for the field measurements. Author (TAB)

N68-38437# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

SELECTED METHODS FOR ANALYZING THE STABILITY OF CRATER SLOPES Final Report

D. C. Banks Jul. 1968 67 p refs

(S-68-8; AD-673997)

The results of a study to select methods for analyzing the stability of crater slopes are presented in this report. Information is given on the nature of input required, such as crater geometry, unit weights, shear strength, and seepage pressures. The selected methods are discussed in detail, and examples of their application are presented. The report does not describe all methods which are found in literature, although these were reviewed during the study. The three selected methods presented are : (a) the Bishop method of slices for circular slip surfaces; (b) the extension of Bishops method to composite failure surfaces as proposed by Janbu and Nonveiller, and (c) the Seed and Sultan method of wedges. These methods were selected as representative of the best available limiting equilibrium procedures. Author (TAB)

N68-38459# Geophysics Corp. of America, Bedford, Mass.

FLUID DYNAMICS ANALOG STUDIES RELATED TO THE DISPERSION OF PARTICLES IN THE UPPER ATMOSPHERE Final Report

Owen Cote Mar. 1968 67 p refs Sponsored by AEC Prepared for Sandia Corp.

(SC-CR-67-2812) CFSTI: HC $3.00/MF $0.65

Motions produced by thermal convection in a rotating fluid-filled annulus bear similarity to motions in the earth's upper atmosphere. To explore the usefulness of this similation to understanding of transport and mixing processes in the atmosphere, flow visualization experiments using dye traces in the annulus were performed. Valuable qualitative and quantitative information on dispersal rates was obtained which provides insight into similar processes in the atmosphere and compares with other studies of transport and diffusion processes. Author (NSA)

N68-38479# Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics.
MATHEMATICAL REPRESENTATION OF THE ALTITUDE RELATIONSHIPS ON THE SURFACE OF THE EARTH, USING SPHERICAL FUNCTIONS TO THE 16TH ORDER
Adalbert Prey 12 Aug. 1968 64 p *Its* Paper No. 22
(Contract N00014-67-A-0298)
(TR-22; AD-673958)

The work is a translation of Adalbert Preys Darstellung der Hohen - und Tiefenverhaltnisse der Erde durch eine entwicklung nach kugelfunktionen bis zur 16. ordnung, Berlin, 1922. A mathematical representation of the entire earths surface is given to assist in solving problems related to gravity variations, movement of the poles, tides and other geo-physical phenomena. Author (TAB)

N68-38495# Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics.
GEOGRAPHY AND AN EXISTENCE THEOREM. A CARTOGRAPHIC COMPUTER SOLUTION TO THE LOCALIZATION ON A SPHERE OF SETS OF EQUAL-VALUED ANTIPODAL POINTS FOR TWO CONTINUOUS DISTRIBUTIONS WITH PRACTICAL APPLICATIONS TO THE REAL EARTH
Stephen E. Selkowitz 5 Aug. 1968 66 p *Its* Paper No. 21
(Contract N00014-67-A-0298)
(TR-21; AD-673957)

Computer mapping is used here to effect the solution to the problem of locating on the earths surface those sets of antipodal points for which equal values occur for some function f and equal values occur for some function g when both of these functions may be regarded as continuous over a sphere. An existence theorem in mathematics (proposed by Ulam and proved by Borsuk) states that at least one such set of antipodal points must always exist. Geographers, naturally enough, are interested in finding the locations of such sets for pertinent real phenomena on the earths surface. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-37543 Ohio State Univ., Columbus.
THE EFFECT OF SCENE MOTION ON HOLOGRAPHY
Don Barker Neumann (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3042

It has been generally accepted that if the scene being recorded by a hologram moves more than a fraction of a wavelength, the brightness of the reconstructed image will be greatly degraded. The cause of this degradation is investigated and the extent of allowable motion is determined for various configurations. The contrast of the recorded fringes is spatially modulated over the hologram. The result of this modulation is a weighting of the amplitude of the reconstructed field which in turn causes a blurring of the reconstructed image. The principle of superposition is shown to hold for the moving scene case of holography, thus allowing much of the analysis to be done using a point source for the scene. Photographs of the reconstructed images are shown for two holograms, one made with a stationary scene and the other with the scene moving. Other considerations in the dissertation include the effect of sinusoidal and other nonlinear scene motions, motion in the input plane of an optical data processor, aperture limitations, the effect of different velocities for different scene points, and applications of the theory to ordinary hologram experiments. Dissert. Abstr.

N68-37546# Los Alamos Scientific Lab., N. Mex.
THE ISOPIESTIC BALANCE
Guy R. B. Elliot 15 Jul. 1968 20 p 7 refs
(Contract W-7405-ENG-36)
(LA-3939-MS) CFSTI: HC $3.00/MF $0.65

Materials, dimensions, and construction of the isopiestic balance for both solids and liquids are described as it was used in 1963. The precision of performance as of that period is discussed. Author (NSA)

N68-37607* Houston Univ., Tex. Wave Propagation Labs.
MODIFICATION OF ULTRASONIC BEAMWIDTHS BY APERTURE CONTROL
F. Boyd and H. S. Hayre 1968 11 p 3 refs
(Contract NAS9-6760)
(NASA-CR-92341; TR-67-25) CSCL 14B

The narrow pencil beam of an ultrasonic transducer can be shaped into a fan beam by appropriate masking of the transducer aperture. The mask described herein was elliptical in shape with semi-minor axis one half the semi-major axis. As expected, the far field pattern parallel to the semi-minor axis was found to be approximately twice that parallel to the semi-major axis. Author

N68-37683* Houston Univ., Tex. Cullen Coll. of Engineering.
DIGITAL DATA ACQUISITION SYSTEM FOR UNDERWATER ACOUSTIC SIMULATOR
H. S. Hayre and S. G. House Jul. 1967 98 p 12 refs
(Contracts NAS9-6760; Nonr-4492(02))
(NASA-CR-92343; TR-67-9) CSCL 14C

The design of a data acquisition system is described for converting underwater signal pulses into digital representation for recording on an incremental magnetic tape. The analog and digital tape recorders and the power supplies were purchased; all the other units of the system were designed and developed for this particular system. Integrated circuits were used for all the digital circuits and discrete components for the analog circuits. The system is capable of handling 3 to 400 microsecond wide pulses of a carrier frequency between 12 kiloHertz and 10 megaHertz with a repetition rate of up to 576 pulses per second. A maximum of 10 samples are taken and converted into 6-bit digital words with a resolution of 1 in 64. Author

N68-37688*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PERFORMANCE OF A BREADBOARD ELECTRONICS SYSTEM DEVELOPED FOR A LUNAR ORBITER GAMMA RAY SPECTROMETER
Albert E. Metzger 1 Oct. 1968 14 p
(Contract NAS7-100)
(NASA-CR-97364; JPL-TR-32-1297) CFSTI: HC $3.00/MF $0.65 CSCL 03A

An electronics system intended to be part of a remote-sensing gamma ray spectrometer has been designed and constructed. This report describes the system and a series of evaluation tests performed on the breadboard model. Results of the test program have been satisfactory, leading to the construction of a space-hardened prototype. Author

N68-37851# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
NEUTRON POLARIMETER WITH HIGH ENERGY RESOLUTION
M. Sieminski, Z. Wilhelmi, W. Zych and P. Zupranski 1968 11 p
(INR-P-897)

A new type of neutron polarimeter utilizing the n-alpha scattering as polarization analyzer is described. The energy resolution obtained for 14-MeV neutrons was about 14%. Author (NSA)

N68-37930# Los Alamos Scientific Lab., N. Mex.
TURBOPUMP VIBRATION MEASUREMENTS AT CRYOGENIC TEMPERATURES
B. W. Washburn [1968] 4 p Presented at 14th Natl. Instr. Soc. of Am., Aerospace Instrumentation Symp., Boston, Jun. 1968
(Contract W-7405-ENG-36)
(LA-DC-9331; CONF-680617-1)

Wide band acceleration instrumentation techniques for the Rover ground test facility dual liquid hydrogen turbopump system are described. Information bandwidths to 50 kHz have been utilized to study structural and flow induced vibrations. Transducer environments vary from 530 to 114°R with complex acceleration levels up to 2000 g's pk-pk. Author (NSA)

N68-37954# Royal Aircraft Establishment, Farnborough (England).
A CONTRIBUTION TO THE STUDY OF THE USE OF 1 PHENYL 3 PYRAZOLIDONE AS A DEVELOPING AGENT [CONTRIBUTIONS A L'ETUDE DE L'UTILISATION DE LA 1 PHENYL 3 PYRAZOLIDONE COMME AGENT DE DEVELOPPEMENT]
A. Wiedermann Jul. 1968 24 p Transl. into ENGLISH from Sci. Ind. Phot. (France), v. 32, no. 4, 1961 p 97–107
(RAE-LIB-TRANS-1313) CFSTI: HC $3.00/MF $0.65

The commercial production of 1 phenyl 3 pyrazolidone (Ilford Phenidone) has led to its increasing use in photographic developers, mainly replacing metol in superadditive mixture with hydroquinone. The effect on Pehnidone-hydroquinone solutions, of alkalization by borax, alkaline carbonates and triethanolamine has been investigated with a wide range of developer dilutions. The addition of other reducing agents (glycine, pyrocatechin) to Phenidone-hydroquinone developers is discussed. Developer formulae for X-ray film, half-tone reproduction materials, silver bromide and chlorobromide papers, and differing negative contrast are listed. Tests on the stability and storage of Phenidone based developers have shown that such solutions are similar to metol-hydroquinone developers in this respect. The versatility of phenylpyrazolidone-hydroquinone solutions makes it possible to adapt them to all professional and amateur needs by varying the concentration, relative proportions of active agents, and type of alkali. Author

N68-37962# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
OPERATIONAL TESTING AND MEASUREMENT OF THE RESOLVING TIME OF A COUNTING ASSEMBLY [TEST DE FONCTIONNEMENT ET MESURE DU TEMPS DE RESOLUTION D'UN ENSEMBLE DE COMPTAGE]
Georges Manent and Jacques de Scheemaecher Jan. 1968 25 p In FRENCH
(CEA-R-3440)

An experiment is described which constitutes a very sensitive test of the satisfactory operation of a counting assembly. It makes it possible to measure the resolving time of an assembly to an accuracy of 1 percent. Examples are presented which show the sensitivity of the test. Author (NSA)

N68-38000# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.
ACOUSTICAL HOLOGRAPHY OF NONEXISTENT WAVEFRONTS DETECTED AT A SINGLE POINT IN SPACE
A. F. Metherell and S. Spinak May 1968 17 p refs *Its* Res. Commun. No. 82
(Douglas-Paper-5150; AD-674753)

An experiment is described in which a hologram is recorded by scanning the source and having the detector stationary. The resulting scanned source hologram is shown to be identical to the conventional scanned detector hologram. The significance of this experiment is that it demonstrates (1) that sampled holograms of an object can be recorded at a single point in space with either a scanning source or an array of sources; (2) that the object wavefront need not actually exist in space but may be geometrically synthesized; and (3) that the object may be illuminated by a changing rather than a stationary wave field. The interesting possibilities which this configuration suggests are briefly discussed. Author (TAB)

N68-38020# Australian National Univ., Canberra. Dept. of Nuclear Physics.
USE OF A DOUBLE-FOCUSSING SPECTROMETER FOR NUCLEAR REACTIONS AT 180°
R. V. Elliott [1968] 6 p refs
(ANU-P-399)

The system described provides a method for using a double-focusing spectrometer to observe reactions at 180° to the beam direction. To account for changes in K, the spectrometer is rotated about the incoming beam direction on an axis parallel to the z-axis. Calculations of the beam trajectories indicate that the method is feasible. The system has the advantages that the area around the target chamber is unencumbered by an auxiliary magnet and that the spectrometer aperture is at 180° to the beam direction for all values of K. Also the system proposed requires a relatively small auxiliary magnet compared with other systems. Author (NSA)

N68-38046# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC MONITORING SYSTEMS FOR VELOCITY AND FLOWRATE FIELDS
G. P. Katys 26 Jan. 1968 453 p refs Transl. into ENGLISH of the book "Sistemy Avtomaticheskogo Kontrolya Polei Skorostei i Raskhodov" Moscow, Izd. Nauka, 1965 p 1–464
(FTD-HT-23-615-67; AD-674736)

Systems for automatic control of velocity fields plus elements of such systems, various methods of scanning and probing control of velocity fields and flow rates; various methods and devices for automatic control of nonstationary flow rates of fluids and gases are analyzed; mass, turbine, ultrasonic, induction, thermal and other flow meters are analyzed. The area of optimal application of these devices are determined; the accuracy of which they are capable and the most promising areas of further development are indicated. Design recommendations are given for most of the meters presented. Author (TAB)

N68-38054# Aeronautical Research Council (Gt. Brit.)
THE EFFECTS OF TURBULENCE ON STATIC-PRESSURE TUBES
P. Bradshaw and D. G. Goodman Sep. 1966 11 p refs Supersedes NPL-AERO-1210; ARC-28327
(ARC-R&M-3527; NPL-AERO-1210; ARC-28327; AD-828408)
HMSO: 5S 6D

Measurements on the centreline of a circular jet confirm the suggestion of Barat and Toomre that the error in static-tube reading due to turbulent fluctuations depends on the ratio of the size of the tube to the size of typical turbulent eddies. The reading of tubes of a size likely to be used in practice is nearer to the

actual static pressure than to either of the theoretical predictions for tubes which are very large or very small compared with the turbulent eddies. Author (TAB)

N68-38066# Sperry Microwave Electronics Co., Clearwater, Fla.
AN/AAR-33 AIRBORNE RADIOMETER SYSTEM Final Report
Dec. 1965 147 p refs
(Contract TCG-02692-1A)
(SJ-230-4980-1; AD-674780)

An airborne, microwave radiometric search set for the detection of icebergs was developed and flight tested. In this report, basic specifications are reviewed, radiometric theory and practice are discussed, design details and development problems are reviewed, radiometer specifications, characteristics, installation and operation are described, and the service approval tests are summarized. The particularly vexing problem with radome aerodynamic characteristics and the solution of the problem are discussed in some detail. Samples of radiometric data over icebergs, ships, sea ice, and over land are given. Author (TAB)

N68-38087# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SHUTTERS FOR AERIAL PHOTO EQUIPMENT
N. P. Zakaznov 14 Dec. 1967 97 p Transl. into ENGLISH from Zatvory Aerofotoapparatov (Moscow), 1965 p 1-86
(FTD-MT-24-294-67; AD-674705)

The monograph is devoted to the design of several types of aerial camera shutters, descriptions of their operational requirements, and prospects for their improvement. It is based on a lecture course given by the author in the Moscow Institute of Engineers of Geodesy, Aerial Photography, and Cartography (MIIGAiK), and summarizes the authors research on the calculation of aerial camera shutter parameters, and on shutter design, published previously in a number of specialized journals. This book is intended for engineers and technicians in the design offices of factories belonging to the optical instrumentation industry, the corresponding scientific research institutes, for students specializing in instrumentation and aerial photogeodesy in institutes of advanced geodetic education. Author (TAB)

N68-38098# Brown Univ., Providence, R. I. Div. of Engineering.
AN ELECTRONIC SYSTEM FOR MEASURING THE ELECTRICAL CHARACTERISTICS OF NONLINEAR DEVICES
W. R. Patterson and M. Kuhn Jul. 1968 37 p refs
(Contract ARPA SD-86)
(ARPA-E58; AD-674853)

An electronic system for obtaining the electrical characteristics of non-linear devices is described. Three modes of operation provide the I-V curve of the sample and either the differential conductance or resistance as a function of sample bias. A simple feedback system is shown to be particularly advantageous for determining the conductance of low impedance devices. A theoretical analysis provides an algorithm for separating the resistive and reactive components of the sample admittance and gives criteria for conditions of optimum stability and minimum noise. Finally the measured characteristics of a number of devices are shown to illustrate the capability of the instrument. Author (TAB)

N68-38111# Brookhaven National Lab., Upton, N. Y.
FLYING IMAGE DIGITIZER. A HIGH-SPEED DIGITIZER FOR TRACK CHAMBER PHOTOGRAPHS
Minato Kawaguti [1968] 10 p Presented at the Intern. Symp. on Nucl. Electron., Versailles, France
(BNL-12679; CONF-680906-1) CFSTI: HC $3.00/MF $0.65

A method for digitizing photographs of track chambers (especially bubble chambers) at a significantly increased rate compared to the current HPD is proposed. The device consists of a thousand solid-state photodetectors which function independently, and rotating mirrors which sweep the enlarged illuminated image of a film across the detectors. The associated problem of pattern recognition is also discussed. Author (NSA)

N68-38131# Curtiss-Wright Corp., Caldwell, N. J. Curtiss Div.
CWEA-4 SONIC ANALYZER WITH UH-1 HELICOPTER CAPABILITY Final Report
W. B. Gray and R. G. Locklin Ft. Eustis, Va. Army Aviation Mater. Labs. May 1968 170 p
(Contract DA-44-177-AMC-446(T))
(C-3030; USAAVLABS-TR-68-28; AD-674198) CFSTI: HC $3.00/MF $0.65

The purpose of the work encompassed in the report was (1) to fabricate a CWEA-4 Diagnostic Sonic Analyzer and (2) to design and fabricate a UH-1 helicopter plug-in module with both T53 engine and UH-1 helicopter power train components capability. The methods employed in achieving this work consisted of (1) analyzing mechanical data to determine the frequencies of the rotating components, (2) performing a microphone survey and locking frequency investigation, (3) analyzing the acoustical data to develop spectral familiarity and to establish initial analyzer programming and system compatibility, and (4) conducting a field application program utilizing the CWEA-4 Sonic Analyzer to correlate analyzer indications with the mechanical condition of the rotating components and to establish analyzer limits. Author (TAB)

N68-38142# Army Engineer Topographic Labs., Fort Belvoir, Va.
STATUS OF AERIAL COLOR PHOTOGRAPHY IN GOVERNMENT AGENCIES
Abraham Anson May 1968 92 p refs
(USAETL-TB-1; AD-674189) CFSTI: HC $3.00/MF $0.65

The utility of aerial color photography for studies in the fields of geology, geography, archaeology, landforms, range management, target detection, highway planning, and hydrology has been recognized by those who are working in aerial photography; however, the usefulness of color has not been determined adequately for Military Geographic Intelligence. This report is a summation of research into the status of aerial color photography in several Government agencies, and its application to specific problems. Author (TAB)

N68-38166* Long Island Univ., Brookville, N. Y. Science Engineering Research Group.
PRECISION MULTISPECTRAL PHOTOGRAPHY FOR EARTH RESOURCES APPLICATIONS
Edward Yost and Sondra Wenderoth 1 Sep. 1968 153 p refs
(Contract NAS9-7291)
(NASA-CR-92360; SERG-TR-04) CFSTI: $3.00 CSCL 14E

The experiment was designed to evaluate the utility of multiband color photography for earth resource applications. A multispectral system was used in which most of the known image forming errors were minimized. The choice of spectral bands was limited by lack of definitive spectral data on environmental objects and was constrained to approximate the spectral sensitivity of color films. Photography, using conventional color films sensitive to the visible and infrared spectrum, was simultaneously taken. Ground control was incorporated for the test site of each discipline which included: calibrated color and grey scale target panels, incident solar radiation, reflectance spectra, and colorimetric measurements. Some of the test results showed: (1) chromatic image errors due to camera, processing and viewer tolerances can be decreased to a point where colorimetric analysis can be reliably performed; (2) variations in the intensity and spectral distribution of solar radiation can be eliminated; and (3) the directional (non-lambertain) spectral reflectance characteristics of objects and the dynamic nature of en vivo reflectance spectra are critical residual environmental parameters. Author

N68-38198# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SPEED SPARK PHOTOGRAPHY WITH A RATE UP TO 40,000 FRAMES PER SECOND [SKOROSTNAYA ISKROVAYA FOTOGRAFIYA S CHASTOTOI DO 40,000 KADR./SEK]
A. N. Berezkin et al Jan. 1968 9 p refs Transl. from the book Aerofizicheskie Issledovaniya Sverkhzvukovykh Techenii (Moscow), 1967 p 227–233
(FTD-MT-24-370-67; AD-674163)

A method for high-speed spark photography is described. The equipment used is capable of producing sparks in a single discharge interval as well as in intervals whose repetition rate is easily found and regulated. The equipment can operate at speeds of 5000 to 40,000 frames/sec, and the usual number of frames exposed at a time is five. The repetition frequency band can easily be widened in both directions. The total number of frames can also be increased by adding more identical units to the equipment. The electronic part of the equipment, which generates sparks at precise intervals, is a multichannel electronic synchronizer which consists of a control circuit and a circuit that generates high-voltage pulses. Electron tubes are used in both circuits. The optical part of the equipment consists of two optical circuits: a circuit for sparks that occur at varying time intervals and a circuit for sparks that occur in a single discharge interval. The equipment was used to photograph non-stationary processes of interaction between a shock wave and objects in shock tubes or on ballistic polygons.
Author (TAB)

N68-38205# Phaostron Instrument and Electronic Co., South Pasadena, Calif.
1% ACCURACY, 40 AND 100 MICROAMPERE RUGGEDIZED TAUT BAND PANEL METERS (5-1/2"-4-1/2") Quarterly Report, 1 May–31 Jul. 1968
Norman Logan and James Coakley Aug. 1968 35 p
(Contract N00024-67-C-1190)
(QR-3; AD-673975) CFSTI: HC $3.00/MF $0.65

A successful high shock test on the first model completed its testing program. Upon its completion, nine units were assembled for a complete specification checkout. Theoretical and experimental studies were conducted to determine the characteristics of four taut bands. Three of these bands were selected on the basis of these studies for the nine units. Theoretical studies of terminal resistance compensation indicated that a deviation of nearly 1% can be achieved. Two forms of shielding -- a nickel mesh and conducting glass -- will be tested for shielding effectiveness against electromagnetic interference. The testing program for the nine units began at the close of the quarter.
Author (TAB)

N68-38324# Honeywell, Inc., St. Paul, Minn. Systems and Research Div.
DEVELOPMENT OF AN EXPERIMENTAL AIRCRAFT HYGROMETER Final Report, 15 Jul. 1965–15 Aug. 1967
Lyle Koehler and John G. Ballinger Oct. 1967 58 p refs
(Contract AF 19(628)-5529)
(Rept.-12020-FR1; AFCRL-67-0608; AD-674631) CFSTI: HC $3.00/MF $0.65

Two experimental aircraft hygrometers using dry-ice heat sinks were designed and constructed, both units recorded frost points below -80C when flight tested at altitudes to 65,000 feet aboard a U-2 aircraft. A third hygrometer which requires no chemical heat sink was also designed, built and laboratory tested. In addition, a heat-transfer analysis was conducted to allow predictions of the instruments capability as a function of altitude, free-air temperature and Mach number. This report describes the instruments and presents analytical and experimental results of the program.
Author (TAB)

N68-38343# Fletcher Paper Co., Alpena, Mich.
COATED PAPER AND DEVELOPER FOR CONTINUOUS TONE ELECTROPHOTOGRAPHY Final Report, Apr.–Dec. 1966
William S. Grimes and George J. Young (Surface Processes Co.) Aug. 1968 131 p refs
(Contract DA-44-009-AMC-1801(X))
(AD-674241) CFSTI: HC $3.00/MF $0.65

The objective was to find a good combination of varnish, zinc oxide, paper, and liquid developer for maximum tone steps and maximum density. The report covers the preparation of laboratory samples of electrophotographic papers and testing for various properties. The samples were evaluated for continuous tone capabilities using various black liquid developers.
Author (TAB)

N68-38353*# Aztec School of Languages, Inc., Acton, Mass.
PULSE COUNTING CHRONOMETER FOR SHOCK-WAVE MEASUREMENTS [SCHETNO-IMPUL'SNYY KHRONOMETER DLYA IZMERENIYA SKOROSTEY UDARNYKH VOLN]
M. V. Gusev, V. A. Gordyushin, and V. D. Lobanov Washington NASA Oct. 1968 6 p Transl. into ENGLISH from the Publ. "Svoistva Gazov Pri Vysokikh Temperaturakh" Moscow, Nauka, 1967 p 154–157
(Contract NASw-1692)
(NASA-TT-F-11942) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A pulse-counting device which can be used for directly determining the time intervals between pulses produced by shock-wave pressure and speed sensors positioned along the path of a shock wave in a shock tube or other shock-wave system is described. This chronometric device is designed to provide immediate information on the operation of such systems, without the time and labor that other available techniques require in treating photographic materials.
Author

N68-38439*# TRW Systems Group, Redondo Beach, Calif.
FLIGHT PROTOTYPE MODEL METEOR FLASH ANALYZER Final Report
F. N. Mastrup and C. D. Bass Apr. 1968 195 p refs
(Contract NAS9-6532)
(NASA-CR-92364; TRW-05202-6015-R000) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A flight prototype Meteor Flash Analyzer with a three-channel radiometer was designed, constructed, and tested. Each channel has video outputs to measure the intensity vs. time variation of individual meteor flashes; and there are a total of 9 meteor data channels for making related measurements. The long wavelength (iron) channel nearly coincides with the conventional spectral range for photographic meteors, providing correlation with ground-based observational data. Detection sensitivity for terrestrial meteors in the iron channel is background radiation limited; and this appears to yield superior sensitivity for the optical detection of meteors in wavelength bands below the ozone limit at ≈0.30 μ. For satellite altitude of naut m, detector field of view of 30°, and detector aperture dia of 5 cm, limiting photographic meteor magnitude was +3.3, with an inverse count rate of 5.6 min/meteor. At 600 naut m, count rate is expected to be 22 min/meteor with a magnitude of −1.1. Significantly larger count rates are expected for the magnesium and silicon channels.
M.W.R.

N68-38467# Los Alamos Scientific Lab., N. Mex.
ADVANCED TRANSIENT WAVEFORM RECORDING TECHNIQUES
Ralph E. Partridge 31 Jul. 1968 63 p refs
(Contract W-7405-ENG-36)
(LA-3919) CFSTI: HC $3.00/MF $0.65

New techniques for transient waveform recording are required for situations where application of conventional oscilloscope-camera

combination approach is not feasible. The recording process is studied in fundamental terms. Avenues to be explored are indicated. New devices and technologies which can be applied are examined. The progress made on this and related problems in the recent past is outlined. Author (NSA)

N68-38476# ARO, Inc., Arnold Air Force Station, Tenn.
ANALYSIS OF THE TECHNIQUES FOR MEASURING PARTICLE SIZE AND DISTRIBUTION FROM FRAUNHOFER DIFFRACTION PATTERNS Final Report, Sep. 1967–Mar. 1968
Ronald A. Belz Arnold Eng. Develop. Center Sep. 1968 94 p refs
(Contract F04600-69-C-0001)
(AEDC-TR-68-125; AD-674741) CFSTI: HC $3.00/MF $0.65

The location and size of particles within a volume which is stationary or dynamic can be found by two techniques of coherent optics. In the first technique the volume is illuminated with coherent light and the resulting diffraction patterns are recorded in the far-field (Frauhofer region) of the particles. The particle information is found from the resultant denaity variations on the film. In the second technique the developed negative (a Fraunhofer hologram) is illuminated with coherent light and the particle field is reconstructed in three dimensions. This investigation is an analysis of these two techniques and their relative merits. Because magnification is important in the second technique the methods of magnifying the volume are discussed. It is found that reconstructing the volume from the hologram yields particle information which is easier to obtain than the information resulting from the diffraction patterns. The volume is also found to be easily and uniformly magnified by an imaging lens in the reconstruction process. Author (TAB)

N68-38482# Naval Radiological Defense Lab., San Francisco, Calif.
A RADIOSOTOPE X-RAY FLUORESCENCE SPECTROMETER WITH A HIGH RESOLUTION SEMICONDUCTOR DETECTOR: DETERMINATION OF ANALYTICAL SENSITIVITY
Sachio Yamamoto May 1968 30 p refs
(USNRDL-TR-68-77; AD-674418) CFSTI: HC $3.00/MF $0.65

The analytical sensitivity of an x-ray fluorescence spectrometer utilizing a radioisotope exciter source and a high-resolution, lithium-drifted silicon detector was evaluated. The spectrometer system which was studied used I125 as the exciter source and contained a 30 sq mm detector with a resolution of 512 eV full-width at half-maximum (FWHM) at 6.40 keV. Known molybdenum samples ranging from 10 nanograms to 1 milligram and nickel samples ranging from 0.1 microgram to 1 milligram were prepared and analyzed. It was found that the detection limit for molybdenum was 35 nanograms with a ca 5 mc exciter source; precision in the submicrogram range was 10-20%. The detection limit for nickel was considerably poorer and was found to be 1 microgram for an exciter source strength of ca 10 mc. An examination of the various factors that affect the analytical sensitivity of the system showed that the sensitivity was limited primarily by (1) poor detector geometry resulting from the small size of the high-resolution Si(Li) detector, and (2) background. A principal contributor to background was backscatter of the exciter source radiation by materials surrounding the source and detector. It was found that the radiation was being scattered mainly by air. Author (TAB)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-37589# Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.
DEVELOPMENT OF AN ENGINE-POWERED LIQUID DISPERSAL SYSTEM FOR AGRICULTURAL AIRCRAFT Final Technical Report
Michael R. Smith, Robert E. Williamson and A. Jack Garrett Jan. 1968 57 p 7 refs
(Contract FA-66-WA-1531)
(DS-68-3)

Results of efforts to design a liquid dispersal system for agricultural aircraft which have low power requirements as compared to standard windmill powered pump systems are presented. The resulting system consisted of a standard spray pump powered from the aircraft engine accessory pad and a spray boom mounted in the wing wake. The maximum power requirement of the final configuration was 12.5 brake horsepower at 100 miles per hour as compared to 52 brake horsepower for the standard system. Significant increases in climb performance and reduction of level flight power requirements were measured. No adverse effects on stall characteristics and control feedback were noted. Author

N68-37603*# General Electric Co., Schenectady, N. Y. Research and Development Center.
PLASMA ELECTRON BEAM WELDER FOR SPACE VEHICLES Final Report
K. L. Boring, T. M. Dickinson, W. Mc Murray, L. H. Stauffer, E. F. Travis et al Aug. 1968 18 p 1 ref
(Contract NAS8-11803)
(NASA-CR-98040; S-68-1116) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A brief, intensive study has been conducted to evaluate the feasibility of developing a compact light-weight Plasma Electron Beam welding system. Such a system would be battery operated and self contained. It is estimated that it would be 12 inches in diameter and 30 inches long, and would weigh 105 pounds. It would deliver 2 kilowatts of focused beam power to a workpiece for a total welding time of approximately 10 minutes. Because of its rugged construction and reliable performance, the PEB gun is well suited to this particular application. At the 2 kilowatt beam power level, it has a life of several hundred hours. Welding tests, conducted as part of this study, have demonstrated good quality welds in 6061 and 2219 type aluminum alloys. Power supply circuitry designs have been analyzed and weights of components have been estimated. The recommended supply uses thyristors (silicon controlled rectifiers) in the inverter circuit which, in conjunction with a transformer and rectifier, convert the 100 volt battery output to 25 kilovolts d-c. This type of circuit is designed to tolerate momentary short circuits, due to gun flash-over, without damage to any of the components. Author

N68-37608*# Pratt and Whitney Aircraft, East Hartford, Conn.
DEVELOPMENT OF COMPRESSOR END SEALS, STATOR INTERSTAGE SEALS, AND STATOR PIVOT SEALS IN ADVANCED AIR BREATHING PROPULSION SYSTEMS Semiannual Report, 1 Jan.–30 Jun. 1968
R. M. Hawkins and A. A. H. McKibbin 19 Jul. 1968 147 p
(Contract NAS3-7605)
(NASA-CR-54628; PWA-3459; SAR-6) CFSTI: HC $3.00/MF $0.65 CSCL 11A

The compressor end and interstage seals are described and procurement of the seals is discussed. There is also a brief discussion of the effects of heat shielding and heating on the one-side floated-shoe interstage seal. In addition, procurement of the stator vane pivot seals and modifications to their associated test apparatus is discussed. Author

N68-37609*# Arde, Inc., Paramus, N. J.
RESEARCH AND DEVELOPMENT ON CRYOGENIC STRETCH-FORMED HELIUM BOTTLES. SATURN 4-B Final Report
Ralph Alper 1968 196 p refs
(Contract NAS8-20713)
(NASA-CR-98041) CFSTI: HC$3.00 CSCL 13H

A program was conducted to establish the manufacturing technology required to produce 22" diameter spherical helium pressure vessels for service at −423F. The vessels incorporated several attachment bosses and a fill port. The material used was a low silicon chromium–nickel stainless steel alloy. The vessels were manufactured by means of the ARDEFORM or cryogenic stretch forming process. Six (6) vessels of the desired configuration were produced for delivery. In addition, mechanical property tests were performed with several heats of this alloy. Author

N68-37716 Pennsylvania State Univ., University Park.
SEPARATION OF SMALL PARTICLES FROM AIR IN A SIEVE PLATE COLUMN
Mansoor Taheri (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-3564

Separation of small particles from air was studied in a sieve plate column to determine the basic factors which control particle collection. The range of particle size studied was 0.05 to 3.0 microns. In this range the relationship between the collection efficiency and particle diameter exhibits a minimum as a result of interplay of inertial and diffusional mechanisms. The influence of the particle diameter, flow parameters and plate geometry were defined and explained. The particle collection data agreed with a mathematical model which was developed on the basis of a combination of inertial mechanism of diffusional mechanism. The pressure drop data in the operating range varied from 2 to 4.0 inches of water. Dissert. Abstr.

N68-37758# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXTRUSION OF ALUMINUM ALLOYS THROUGH A WATER-COOLED DIE [PRESSOVANIIE ALYUMINNEVYKH SPLAVOV CHEREZ VODOOKHLAZHDAEMUYU MATRITSU]
A. I. Baturin 21 Jul. 1967 18 p 4 refs Transl. into ENGLISH from Kuznechno-Shtampovochnoye Proizv (USSR), no. 8, 1966 p 5–9
(FTD-HT-67-229; AD-671558)

A method of extruding aluminum alloy through a water-cooled die was developed and introduced in industry. Production-scale tests were carried out in a 1500-ton press equipped with a water-cooled die through which D16 and AMg6 aluminum-alloy tubes, 33-53 mm in outside diameter with a wall thickness of 3-10 mm, were extruded from 156 mm x 64 mm x 340 mm ingots. It was established that the use of a water-cooled die made it possible to increase the extrusion rate from 2.56-3.3 m/min to 3.6-5.0 m/min without a significant increase of extrusion force. The water flow should not start until 0.5-1.2 mm of the tube has cleared the die, and then the water should be fed in cycles. The cooling has no negative effect on structure, mechanical properties and corrosion resistance of either extruded or extruded and cold-rolled tubes. The surface quality of tubes extruded through the water-cooled die is somewhat better than that of conventionally extruded tubes because the metal does not stick to the die. TAB

N68-37810*# Wilmot Castle Co., Rochester, N.Y. Research Lab.
EVALUATION OF FILTERS TO STERILIZE LIQUIDS AND GASES Final Report
Robert R. Ernst 1 Apr. 1968 159 p 17 p Prepared for JPL
(Contracts NAS7-100; JPL-951489)
(NASA-CR-97352) CFSTI: HC $3.00/MF $0.65 CSCL 13K

The evaluation of filters used to sterilize liquids and gases included not only filters, but the apparatus and procedure. In many cases the filters were found to be adequate, but the equipment, such as filtration assemblies, suggested for use were found to cause failure, either because of inadequate seals or fragility. The investigation covered four broad and major categories: (1) Testing of high efficiency particulate air (HEPA) filters. Prior to the actual testing of HEPA filters, it was necessary to evaluate procedures and the effects of certain physical forces and their influence on the ultimate data. These included aerosolizing means and media, gravitational and electrostatic forces affecting precipitation, fallout, and impingement, isolinetic relationships, and sampling means. (2) Evaluation of membrane filters and filtration methods. (3) Evaluation of filters and filtration of liquids under pressure. (4) Evaluation of filters and filtration methods for sterilizing gases under pressure. Author

N68-37817# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF BALLBEARINGS WORKING UNDER COMBINED LOADS
M. A. Leikand Dec. 1967 46 p 6 refs Transl. into ENGLISH from Sb. Statei, Prochnost Dinam. Aviats. Dvigatelei (USSR), no. 3, 1966 p 273–308
(AD-674689; FTD-MT-24-334-67)

The work is dedicated to further improvement of methods of the calculation of ballbearings under a combined load (radial and axial loading). Initial equations consider change of the angle of contact depending upon the position of the ball with respect to the plane of the load. The method of calculation described in the work permits obtaining definitized values of reduced loads. Reduced loads calculated by this method are lower than reduced loads found by other methods, including the method recommended by the international organization on standardization ISO, which opens defined possibilities of more full use of the carrying capacity of radial and thrust ballbearings under combined loads. Author (TAB)

N68-37857*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF THERMAL STRESSES AND METAL MOVEMENT DURING WELDING Final Report
Koichi Masubuchi (Battelle Mem. Inst., Columbus, Ohio), F. B. Simmons (Battelle Mem. Inst., Columbus, Ohio) and R. E. Monroe (Battelle Mem. Inst., Columbus, Ohio) Redstone Arsenal, Ala. Redstone Sci. Information Center 1 Jul. 1968 155 p 62 refs Sponsored in part by Army Missile Command
(Contract DA-01-021-AMC-14693(Z))
(NASA-TM-X-61300; RSIC-820) CFSTI: $3.00 CSCL 13H

A literature survey on thermal stresses during welding and buckling, after welding is described. From the analyses found, a computer program was developed to calculate thermal stresses and resulting residual stresses due to a moving heat source. This program is included in the appendix. Studies on three-dimensional movement during welding of flat plate specimens are summarized and interpreted on the basis of the Battelle literature survey and computer analysis. It is concluded that local metal movement during welding appears to be caused by bending moment and that general metal movement is apparently caused by buckling. Future programs to improve the present analysis are recommended. Author

N68-37901*# Whittaker Corp., San Diego, Calif. Advanced Composites Engineering Dept.
DESIGN, DEVELOPMENT, AND FABRICATION OF A FUNCTIONAL ADHESIVE BONDING REPAIR EXPERIMENT TO BE PERFORMED DURING SPACE FLIGHT Final Report, Nov. 1966–May 1968
S. Feher May 1968 20 p
(Contract NAS8-20677)
(NASA-CR-98003) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Three specially formulated adhesive systems were developed for application in the space adhesive bonding repair experiment. The three adhesive systems are suitable for application in the zero-g, hard vacuum space environment over a temperature range from 30°F to 130°F, yielding tensile shear strengths in excess of 1000 psi. A suitable adhesive package, dispenser, and vacuum glove box were developed to carry out the adhesive bonding repair experiment in the SIV-B work shop. Author

N68-37965# Mainz Univ. (West Germany). Inst. fuer Angewandte Physik.
STUDY GROUP FOR SUSPENDED MATTER TECHNIQUE. SUSPENDED MATTER TECHNIQUE MEETING OF 1967 [ARBEITSGEMEINSCHAFT FUER SCHWEBSTOFFTECHNIK. SCHWEBSTOFFTECHNISCHE ARBEITSTAGUNG, 1967]
Dec. 1967 51 p refs In GERMAN Presented at a Symp. of the Inst. fuer Angew. Phys., Mainz, Dec. 1967
(CONF-671214)

Nineteen papers presented at the conference on the technology of suspended matter are compiled. The topics discussed are: fine sieves with pores under 0.1 μm for sampling of suspended matter, electrical precipitation of radioactive aerosols, electron microscopic determination of flattening factors and size of cloud drops, comparison of several surface measurement methods, impactor system for study of air colloidal substances, methods for detection of organic air colloidal components in the atmosphere, ultrafine aerosols in reactor technology, ratio between dust and nuclei in various air masses, studies on the vertical distribution of carbon monoxide in roads with high commercial traffic, development of electron scattered gasoline injection in Volkswagen motor, chemical composition of atmospheric aerosols, measurement of the refraction index of atmospheric and aerosol particles, production of ultrafine aerosols, mobility and diffusion coefficients of natural and artificial radioactive ions, mobility of small ions in air, detection of the scattered light by ultrafine aerosols, and analysis of β decay curves of radioactive aerosols after atom bomb tests. NSA

N68-37983 Technische Hochschule Hannover (West Germany).
STRUCTURE INVESTIGATION OF NICKEL FILMS VAPOR-DEPOSITED ON GLASS BASES [STRUKTURUNTERSUCHUNGEN AN AUF GLASUNTERLAGEN AUFGEDAMPFTEN NICKELFILMEN]
Peter Wissmann (Ph.D. Thesis) 1967 114 p refs In GERMAN
CFSTI: $3.00

Temperature and substrate effects on the microstructure of nickel films deposited on glass panels were studied. X-ray diffraction and electric resistance measurements on vapor deposited nickel films showed that different thermal expansion coefficients for film and substrate were responsible for characteristic lattice contractions during cooling; increased film thicknesses resulted in decreased lattice constants. Structural analysis revealed that those crystallites with (111)- lactice levels parallel to the glass base grew faster than (200)- and (300)- oriented crystallites. Thermal expansion coefficients proved that thick layer films annealed at high temperatures possessed pronounced (111)- crystalline structures. Transl. by G.G.

N68-38031# Army Weapons Command, Rock Island, Ill. Science and Technology Lab.
EVALUATION OF RUBBER TO METAL BONDING AGENTS
Elmer I. Spearman Jun. 1968 18 p refs
(RIA-68-1558; AD-674655) CFSTI: HC $3.00/MF $0.65

An evaluation of commercially available rubber to metal bonding agents was made using several common elastomers and steel and aluminum. It was desired to find optimum systems for bonding these metals to synthetic rubber compounds for use in military specifications. Satisfactory bonding systems were found for all elastomers investigated, including EPDM and butyl rubbers. No significant difference in bond strength was found for various types of metal surface treatments. Author (TAB)

N68-38082# Martin Co., Denver, Colo.
CENTER FOR HIGH ENERGY FORMING Technical Quarterly Progress Report No. 12
Jimmy D. Mote 1 Jul. 1968 30 p
(Contract DA-19-066-AMC-266(X); ARPA Order 720)
(AMRA-CR-66-05/14; AD-674197) CFSTI: HC $3.00/MF $0.65

Contents: Springback and mechanics of blank deformation; Mechanics of energy transfer and high velocity metal deformation; Strain rate effects; Electromagnetic and electrohydraulic forming; Comparison of terminal properties of explosively and conventionally formed Aluminum alloy 2014; and Properties of explosively formed AISI Steels 4130, 4140 and 4340. TAB

N68-38092# Joint Publications Research Service, Washington, D. C.
EMPLOYMENT OF ELECTRICAL THERMOMECHANICAL TREATMENT FOR PRODUCTION OF HIGH-STRENGTH WIRE
I. N. Kidin et al *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 27-34 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 1, 1966 p 141-144 (See N68-38089 24-17)

Electron microscope studies on steel wire after electrical thermomechanical treatment and temper demonstrated that formation of austenite is accompanied by breaking-up of grains into a number of fragments within oriented subboundaries of characteristic polygon structure. Cold drawing after induction heating produced a wire in which high strength combined with plasticity and reached an ultimate strength of 240 kg/mm^2 at 28 to 32% reduction in area; 22 to 24 kinks and 20 to 22 twists were obtained on a 1.28 mm-diameter steel wire. G.G.

N68-38101*# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
BONDING LARGE AREA SILICON WAFERS Quarterly Report
Oct. 1968 50 p Prepared for JPL
(Contracts NAS7-100; JPL-952022)
(NASA-CR-97417; QR-5) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Progress in both solid-solid and solid-liquid diffusion bonding is described. The problem of voiding is discussed and solutions, where they have been obtained, are presented. A void-free solid-solid bonding scheme for inter-wafer bonds has been achieved and the results are shown. Elimination of gas filled voids in the solid-liquid case can be achieved by eliminating the electrodeposition of low melting point materials. Bonds of 1-inch wafers to appropriate heat sinks are shown as prototypes to the large area bond of an actual circuit. The progress in the measurement of thermophysical properties is reported. Expansion coefficients of several common solders are given as well as the elastic modulii for the Ag-In system. The results of the computer stress analysis for a 1-inch diameter trilayer system are presented. Curves for radial, hoop, "Z" and sheer stress as a function of radius and depth in the silicon wafer are shown and implications on device performance are discussed. Author

N68-38123# Mechanical Technology, Inc., Latham, N. Y.
DESIGN DATA OF GAS-LUBRICATED SPIN-AXIS BEARINGS FOR GYROSCOPES Final Report
J. H. Vohr and C. H. Pan 17 Jun. 1968 181 p refs
(Contract N00014-67-C-0530)
(MTI-68TR29; AD-673988) CFSTI: HC $3.00/MF $0.65

This document contains analytically derived design data for four types of gas lubricated self-acting bearings which are commonly used for the suspension of the spin axis of gyroscopes. Information prepared includes geometrical parameters of the overall bearing package as well as surface features for the optimum design of each of the four bearing types. Performance data given are stiffness, friction, critical mass for stability and frequency of instability. The design data is supplemented by theoretical background and illustrative examples. Author (TAB)

N68-38136# Army Mobility Equipment Command, Fort Belvoir, Va. Research and Development Center.
PERFORMANCE EVALUATION OF FILTER/COALESCER ELEMENTS WITH VARIOUS MILITARY FUELS Final Report, Nov. 1966–May 1967
Robert N. Brown Jul. 1968 28 p
(Rept.-1931; AD-674645) CFSTI: HC $3.00/MF $0.65

The report covers the performance evaluation of military, standard-dimension, filter/coalescer elements when removing water and solids contaminants from various military fuels. The report concludes that: (1) MoGas and No. 2 diesel fuel currently being supplied to military users contain detergent and dispersant-type additives which adversely affect the water- and solids-removal performance of a modern filter/separator; (2) After the MoGas and No. 2 diesel fuel are filtered through fullers earth or clay filters, the elements met the specification requirements described in the report; (3) With AvGas, the element performance in removing 3% water and red iron oxide was marginal but not considered unsatisfactory. Author (TAB)

N68-38199*# Ladish Co., Cudahy, Wis.
PRODUCTION OF A LARGE, ROLLED RING FORGING OF "200" GRADE MARAGING STEEL Final Technical Report
T. J. Lillie 29 Feb. 1968 120 p
(Contract NAS3-7966)
(NASA-CR-72451; Rept.-03-119) CFSTI: HC $3.00/MF $0.65
CSCL 13H

A seamless, thin walled, high face height cylinder of maraging steel was produced by the roll forming process. The manufacturing process included hot forging (by seamless ring rolling) a 28,510 pound, vacuum melted ingot into a 260-inch diameter ring blank and then doubling the length of the ring blank by roll forming at ambient temperature. Mechanical properties are reported. Author

N68-38206# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXTRUSION OF TOOL STEEL WITHOUT PRESS RESIDUES [VYDAVLIVANIE INTRUMENTALNOI STALI BEZ PRESSOSTATKA]
V. P. Severdenko, V. S. Muras, and E. Sh. Sukhodrev 8 Sep. 1967 10 p Transl. into ENGLISH from Izv. Akad. Nauk BSSR, Ser. Fiz-Tekhn. (USSR), no. 3, 1965 p 93–95
(FTD-HT-67-413; AD-674155) CFSTI: HC $3.00/MF $0.65

A method of butt-free hot extrusion of solid and hollow shapes from structural and high-alloy tool steels is described. The principle of this method is as follows: an intermediate link or insert is placed in between the punch and the forging; the height of the insert is not lower than that of the die. The material of this insert must withstand considerable loads without a change in its properties, its strength should be lower than the strength of the extruded metal and it should display the qualities of a lubricant. So far, of the materials investigated for this purpose, the best results were displayed by a graphite-clay-silica mixture subjected to thermal or chemical hardening after its molding remains of the carbon electrodes of electric arc furnaces also are suitable. This development not only assures a successful butt-free hot extrusion but also displays other positive aspects. Thus, early during the extrusion part of the insert flows into the gap between the punch and the container and, throughout the distance traveled by the punch, provides a uniform layer of lubricant, which completely precludes jamming of the punch. Toward the end of the extrusion the material passes through the die and disintegrates into powder, which facilitates its removal for re-use. This technique also improves the conditions for automating the process of hot extrusion. TAB

N68-38230# Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.
ELASTIC CONSTANTS OF SMALL SINTERED CERAMIC SPECIMENS Final Report, Jun. 1966–Jun. 1967
Edward Schreiber and Orson L. Anderson Wright-Patterson AFB, Ohio AF Mater. Lab. Jun. 1968 72 p refs
(Contract AF 33(615)-1700)
(AFML-TR-65-202, Pt. 3; AD-674069) CFSTI: HC $3.00/MF $0.65

A method of fabricating specimens in order to measure elastic properties is described. The instrument, a pneumatic sphere grinder has been evaluated by measuring the wear rate upon several different specimens of moderate mechanical hardness. The wear rate is proportional to the mass of the specimen as it is ground to a spherical shape, and was found to have an almost linear dependence upon the input pressure. Author (TAB)

N68-38304# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORGING OF LARGE FORGED PIECES (CHAPTER 2)
V. N. Trubina et al 22 Sep. 1967 47 p refs Transl. from the book "Kovka Krupnykh Pokovok" Mashinostroyeniye, Moscow, 1965 p 28–36, 260–288
(FTD-HT-67-491; AD-674039) CFSTI: HC $3.00/MF $0.65

The article covers: the heating of billets and blanks for forging using structural carbon and alloy steels; the mechanical properties of disks forged at various temperature conditions; a new method for forging pieces of turbine and compressor disks and lids on floating blocks under hydraulic presses; and technological factors determining the deformation of metal during rolling of forged lead, aluminum, and steel blanks. Tables and diagrams are presented to illustrate more thoroughly the processes used. TAB

N68-38366# Union Carbide Nuclear Co., Oak Ridge, Tenn.
METALLOGRAPHIC EXAMINATION OF POROUS MATERIALS
L. M. Doney, C. E. Holcombe, and H. S. Avant 30 Jul. 1968 15 p refs
(Contract W-7405-ENG-26)
(Y-1625) CFSTI: HC $3.00/MF $0.65

Specimens of porous materials as Be, W, carbon foam, and ceramics, are prepared for photomicrography by standard metallographic techniques after impregnating with a low melting point alloy, such as Cerrobend, to prevent mechanical pullout. Author (NSA)

N68-38448# Defence Standards Labs., Maribyrnong (Australia).
THE DETERMINATION OF WELDING FILTER TRANSMITTANCES WITH A CARY 14R SPECTROPHOTOMETER
B. A. J. Clark May 1968 17 p
(Rept.-314) CFSTI: HC $3.00/MF $0.65

A cell space horizontal slit attenuator was used in a Cary Model 14R spectrophotometer to make transmittance measurements, in the range 270nm to 2.6μm, of welding filters of up to shade 12 for which the luminous transmission factor is about 0.002%. The attenuator can provide a useful reduction in reference beam intensity of up to 1000 times, and this, coupled with the 10X scale expansion switch allows the pen to indicate at full scale deflection a transmittance of only 0.01% in the ultraviolet and visible ranges of the instrument. In the infrared range, the smallest full scale

deflection value obtainable without the excessive pen noise is about 0.1%. Curves showing the factors by which the observed transmittances need to be multiplied in order to correct for spectral non-neutrality of the attenuator are given; these curves are estimated to have errors of less than 2% for slit attenuations of up to 100, and possibly for up to 1000. The attenuator can be set to a nominal attenuation of 10 with an estimated proportional error of less than 2%, for further factors of 10 in attenuation the errors add statistically. Even for shade 12 filters the absolute errors in determining the specified mean transmission values and the luminous transmission factor are not expected to exceed 0.001%.
Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-37486 California Inst. of Tech., Pasadena.
NONLINEAR AND ANISOTROPIC EFFECTS IN MAGNETICALLY TUNED LASER AMPLIFIERS
Andrew Dienes (Ph.D. Thesis) 1967 238 p
Available from Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 67-17060

Using semiclassical radiation theory and a density matrix formalism we analyze the nonlinear characteristics of a gas laser amplifier operating with two optical frequency signals of arbitrary polarization and having an axial magnetic field. Both perturbational solutions, valid for relatively weak intensities and solutions valid for arbitrarily strong fields are obtained for two nonlinear effects: the saturation interaction of the electromagnetic waves, and the generation of combination tones. An arbitrary amount of Doppler broadening is considered throughout. The detailed treatment of J = 1 to J = 0 model yields the frequency, magnetic field and polarization dependence of the nonlinear effects. The results are presented analytically and graphically and are discussed using physical arguments. It is found that only saturation but no combination tone generation occurs for two opposite circularly polarized input signals while both are, in general, present for two arbitrary linearly or elliptically polarized fields. Dissert. Abstr.

N68-37755 Technische Hochschule in Wien (Austria). Institut fuer Hochfrequenztechnik.
SIGNAL CONVERSION BY MULTIPLE MODULATION IN OPTICAL COMMUNICATION SYSTEMS
G. Schiffner, W. Leeb, and H. Kindl 20 Sep. 1968 7 p 5 refs
Presented at the 7th Intern. Conf. on Microwave and Opt. Generation and Amplification, Hamburg, 16-20 Sep. 1968
Sponsored by the Austrian Govt.

Contained herein is a method for conversion of signals which are modulated on a laser beam. In its simplest form the arrangement consists of two light modulators driven by frequencies ω_1 and ω_2, respectively. The modulation spectrum of the emergent beam contains the frequencies $(2k-1)\omega_1 \pm (2l-1)\omega_2$ $(k,l = 1,2,3,\ldots)$ in the case of two electrooptic modulators. Using improved arrangements it is possible to cancel some frequencies. Experiments confirmed the theoretical considerations. We propose to use the arrangements for down conversion of signals modulated on a laser beam to a frequency range where sensitive detectors with appropriate speed are available.
Author

N68-37775*# Stanford Univ., Calif. Microwave Lab.
STUDY OF LASER FREQUENCY STABILITY AND SPECTRAL PURITY Semiannual Status Report, 1 Mar.-31 Aug. 1968
A. E. Siegman Sep. 1968 8 p 1 ref
(Grant NGR-05-020-234)
(NASA-CR-97345; ML-1678; SASR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Quantum phase noise and plasma induced phase noise in He-Ne lasers were investigated. Measurement of quantum phase noise in laser oscillators involved techniques similar to those used in determinations of the total linewidth of a laser oscillator. Quantum phase noise measurements using a 30 MHz FM discriminator and a high frequency sampling scope indicated that spontaneous emission noise can be measured in spite of the presence of relatively large external noise contributions. Spectral linewidths in the kilohertz range were obtained from 6328 Å He-Ne lasers, and perturbations within the gas discharge are considered an explanation of the residual broadening in linewidth. Experimental results indicate that the spectral width of 6328 Å lasers may be due to plasma effects.
M.W.R.

N68-37809*# Stanford Univ., Calif. Dept. of Electrical Eng.
FURTHER MEASUREMENTS OF QUANTUM PHASE NOISE IN A He-Ne LASER
R. Arrathoon and A. E. Siegman 1968 10 p 4 refs
(Grant NGR-05-020-234)
(NASA-CR-97356) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Extended measurements of laser frequency fluctuations, using improved instrumentation, provide further verification of the Schawlow-Townes relation for the spontaneous emission limited line-width of a laser oscillator.
Author

N68-37839*# California Univ., Los Angeles. Dept. of Engineering.
INFRARED LASERS AND OPTICAL PROPERTIES Semiannual Report, Period Ending 31 Oct. 1968
O. M. Stafsudd 31 Oct. 1968 7 p
(Grant NGL-05-007-161)
(NASA-CR-97315; Rept.-68-58) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Research activities are reported in far infrared laser construction and operation, Brewster windowed water vapor laser development, direct gain measurements, Q switching, and materials preparation and measurement. Two screens of modulation appeared to be plausible; one used the electrooptical effect, the other free carrier absorption. A literature search was made of crystal structure and growth for the electrooptical screen.
M.W.R.

N68-37855*# Raytheon Co., Waltham, Mass. Research Div.
A STUDY OF HIGH POWER ARGON LASER OPTICS Final Report, 15 Apr. 1967-14 Apr. 1968
George de Mars, Michael Seiden, and Frank Horrigan Aug. 1968 58 p 5 refs
(Contract NAS12-548)
(NASA-CR-86111; S-1078) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The development, over the past several years, of high power, continuous duty, argon ion lasers has encountered limitations in the form of a severe optical degradation problem. An absorbing film builds gradually on the optical components which terminate the discharge tube. This layer absorbs a small fraction of the laser power, thermally distorts the optical components, and unbalances the optical cavity. In this way the laser power that can be extracted is limited to some value far below the inherent capabilities of the active medium. Experimental investigations of Brewster-angle window degradation were performed on a large quartz bore laser capable of cw powers in excess of 100 watts. Methods of recognizing and measuring the extent of window damage were

established. Studies of the transport processes suggested that the motion of charged particles under the influence of the plasma fields is the dominant mechanism by which the contaminants reach the terminal optics. On the basis of the understanding achieved during this study, various techniques to modify or prevent the degradation were developed and assessed. Author

N68-37868*# Raytheon Co., Waltham, Mass.
A STUDY OF HIGH POWER ARGON LASER OPTICS Interim Scientific Report, 15 Apr.–31 Oct. 1967
George de Mars, Michael Seiden and Frank Horrigan Nov. 1967 30 p 4 refs
(Contract NAS12-548)
(NASA-CR-86110; S-1015) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The development of high power, continuous duty, argon lasers has produced optical power levels, within the laser cavity, in excess of 1 kW/cm^2. Optical components have shown degradation or failure at such power levels, particularly when exposed to the environment of the high current density, ionized gas discharge. The critical optical interface is located at the surface which terminates the discharge tube. A layer develops at this surface which absorbs a fraction of the power present, sufficient to result in thermal distortion. Various studies were started to observe and understand the nature of optical degradation of mirrors and windows exposed to high levels of optical power. The thermal distortion of windows has been documented and correlated with theory. Mirror studies have been empirical. Author

N68-37894# Library of Congress, Washington, D.C. Aerospace Technology Div.
OPEN MILLIMETER-BAND RESONATORS
Stuart G. Hibben *In its* Foreign Sci. Bull., Vol. 4, No. 9 Sep. 1968 p 1–30 13 refs (See N68-37863 24-23)

Several types of open microwave resonators, designed on quasi-optical principles, have operated successfully as generators in the millimeter band. The test models exhibit high Q and low spectral densities. The techniques developed show promise for extending open resonator design into the submillimeter range. Author

N68-38160*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE PROCUREMENT AND EVALUATION OF A PROTOTYPE LASER SATELLITE-TRACKING SYSTEM Final Report, 1 Jan. 1967–30 Sep. 1968
Charles A. Lundquist, G. G. Lehr, L. A. Maestre, and P. H. Anderson Sep. 1968 43 p refs
(Contract NSR-09-015-039)
(NASA-CR-97355) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Details are presented on the prototype laser ranging system designed for future geodetic and geophysical investigations. Descriptions are given of the following main components: the static pointing pedestal for the photoreceiver and the transmitter; the pulsed ruby laser transmitter system; the telescope photoreceiver to be used with a photomultiplier tube; and the electronics for controlling and recording the laser pulse data. The procurement and evaluation of the components are reviewed. It is pointed out that the reduction of the range observations is easy and rapid, and corrections are needed only for time delays and the laser pulse velocity. The mechanical, electrical, and optical hazards are discussed, and a list of laser safety regulations is included. It is felt that the laser system is simple to operate, yields precise results within minutes, and permits the acquisition of tracking data when the sky is too bright for visual observation or when the satellite is in the earth's shadow. N.E.N.

N68-38237# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE QUALITY MODULATOR OF AN OPTICAL QUANTUM GENERATOR ON A RUBY [MODULYATOR DOBROTNOSTI OPTICHESKOGO KVANTOVOGO GENERATORA NA RUBINE]
Yu. V. Baiborodin, V. I. Kravchenko, E. N. Kabanov, A. S. Karpenko, and A. V. Kozin Oct. 1967 7 p refs Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Upr. (USSR), no. 4, 1966 p 40–42
(FTD-HT-23-735-67; AD-673922)

A Q factor modulator that increases the output pulse power of a ruby laser by 1000 is described. The modulator is made up of an optical head and an electronic unit. The optical head consists of a rotating prism with total internal reflection that acts as one of the mirrors of the laser optical resonator; it is driven at angular speeds up to 26,000 rpm by a dc motor. The Electronic unit consists of a square wave generator, a comparator circuit, two time delay networks, a trigger circuit, a dc motor, and a power supply. The modulator operates in the following manner: at a given angular position of the prism with respect to the laser beam, light from a lamp is focused through a lens and illuminates a photosensitive diode. The output pulse of the photodiode is amplified and fed to the comparator. When the rotational speeds of the motor and the prism are equal, the comparator initiates a pulse that lights the laser pumping lamp and thus triggers the laser. At the same time, the motor is stopped and the laser is not triggered again until the motor builds up its speed until it is equal to that of the prism. The motor has an automatic disconnect relay which stops it in 5 to 7 seconds if a faulty condition occurs in the circuit. Author (TAB)

N68-38256*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LASER BEAM POINTING TESTS
C. O. Alley and D. G. Currie *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 329–335 refs (See N68-38246 24-30)

Six transmitting stations, each with an argon-ion laser having a suitable optical system for collimating and aiming the laser beam, were established to pinpoint specific locations on the lunar surface by using the detection sensitivity of the Surveyor VII vidicon camera operating in its integration mode. All six stations used the technique of directing the laser beam backward through a telescope to reduce the beam divergence, although each station used a different method for aiming the laser beam. The 1-W laser beams appeared as bright stars, while the uncollimated light from major cities was not detected during these experiments. M.W.R.

N68-38301# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRISM SHUTTER WITH PERIODIC OPENINGS [PRYZMOVY I ZATVOR Z PERIODYCHNYM VVIMKNENNYAM]
Yu. V. Baiborodin et al 21 Sep. 1967 6 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 10, no. 8, 1965 p 919–920
(FTD-HT-67-404; AD-674225) CFSTI: HC $3.00/MF $0.65

A multi-prism Q switch is described, consisting of a rotating prism set on the shaft of an electric motor and a series of 60 totally reflecting prisms set on an annulus. The construction allows precise adjustment of the rotating prism relative to the ruby crystal of the laser and relative to the other prisms. Rotation of the setup results in multiple opening of the shutter which in turn leads to generation of a series of laser pulses. The rate of opening in this system is twice as large as with a single-prism Q switch. The repetition rate of the pulses depends on the rate of revolution of the motor and the number of prisms on the annulus, and the number of generated pulses depends on the length of the illumination of the pump lamp and the frequency of closing the optical resonator. A repetition rate of 20 cps with a length of the illumination pulse of 2 msec resulted in a rate of 4 to 20 pulses, depending on the pump energy. A simple synchronization system of the pump results in giant light pulses with a peak close to 1 MW. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-37442# Atomics International, Canoga Park, Calif.
SOLUBILITY OF COPPER IN SODIUM
R. L. Eichelberger and R. L. Mc Kisson 31 May 1968 22 p 4 refs
(Contract AT(04-3)-701)
(AI-AEC-12671) CFSTI: HC $3.00/MF $0.65

The solubility of copper in sodium has been studied in the temperature range of 250° to 726°C, using a very high purity sodium and oxygen free high conductivity (OFHC) copper. A capsule technique was used for the experiments, with the sodium exposed only to high vacuum. Chemical analysis was performed using colorimetry and atomic absorption spectrometry. Results of the 21 experiments reported between 350° and 726°C were combined with those from two other studies to give the expression $\log_{10}$S(ppM Cu in Na) = 5.957–3430/T(°K), based on 39 data points and covering the temperature range of 245° to 726°C.
Author (NSA)

N68-37445 Virginia Univ., Charlottesville.
THE TEMPERATURE AND MAGNETIC FIELD DEPENDENCE OF THE RESISTIVITY OF NICKEL AND COBALT
John William Reichardt (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-3120

The transverse magnetoresistance of nickel and cobalt single crystal whiskers has been measured at 4.2, 77, and 294° Kelvin. The longitudinal magnetoresistance of single crystal nickel whiskers has been measured at 4.2 and 294°K. The longitudinal magnetoresistance of single crystal cobalt whiskers has been measured in the range 1.1 to 4.2°K. The magnetoresistance data are discussed in terms of the magnetic state of the crystals and in terms of the existing theory. Shubnikov-de Haas oscillations have been observed in the longitudinal magnetoresistance of a cobalt single crystal oriented along the c axis. The oscillations are probably due to magnetic breakdown. The dependence of the resistivity of cobalt on temperature has been measured between 1.1 and 4.2°K. The data are fitted to an equation of the form $R(H,T)/R(0,294) = a + bT + cT^2$. Measurements were taken at zero magnetic field and at 50 kilooersteds. The results are interpreted in terms of the theory of electron magnon scattering.
Dissert. Abstr.

N68-37480 Virginia Univ., Charlottesville.
MICROWAVE PROPERTIES OF THIN METAL FILMS
Thomas Skipwith Lewis (Sc.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17656

Expressions are derived for transmission, reflection and absorption coefficients of thin metal films positioned in the transverse plane of rectangular waveguide. The analysis is confined to consideration of the TE_{10} mode. The results are plotted as a function of film thickness for iron, nickel and silver at 9800 MHz, using two relations for conductivity in the plane of a thin film. It is apparent from the curves that transmission is very low even for films much thinner than skin depth. Experimental data are taken at 9800 MHz for the above materials and compared with the derived expressions using measured values of conductivity. The correlation is good for iron and nickel, but silver exhibits more transmission and less reflection than the expressions indicate.
Dissert. Abstr.

N68-37482# Rutgers Univ., New Brunswick, N. J. Bureau of Engineering Research.
MECHANISMS OF EROSION OF DUCTILE METALS BY SOLID IMPINGEMENT Final Report
Mark B. Moore Mar. 1968 23 p 6 refs
(Contract AT(30-1)-3477)
(NYO-3477-12) CFSTI: HC $3.00/MF $0.65

The rate of loss of material from an eroded ductile metal surface was found to be a function of the rate of energy transfer from the eroding particles to the surface, as well as a function of the angle of incidence of the particles upon the surface. Three separate phases or types of erosion were identified, and the mechanisms of each phase were studied and presented. The concentration of eroding particles in the carrier gas was found to have an effect upon the erosion rate, but particle velocity and particle size effects were quite small within the test limits.
Author (NSA)

N68-37516 Cornell Univ., Ithaca, N. Y.
MICROSTRESS CHARACTERISTICS OF DUCTILE AND BRITTLE MOLYBDENUM
Charles David Turk (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-3518

The microplastic properties of arc-cast, TZM, and powder metallurgical molybdenum sheet were investigated in tension at room temperature. Plastic strains of 1×10^{-6} in/in. to 1×10^{-4} in/in. were measured using resistance strain gage techniques. Grain sizes were varied in order to establish a ductile-to-brittle grain size transition. A two stage microstrain curve consisting of a region of high work hardening and one of dynamic recovery resulted for the arc-cast molydenum, while only a single stage was evident for the powder metallurgical and TZM molybdenum. The coarse-grained brittle samples exhibited less work hardening in the microstrain region and lower microyield points. Increasing the strain rate of the arc-cast molybdenum suppresses the first stage of work hardening. The transition in the work hardening in the microstrain region supports other data in which it is postulated that the transaction stress represents the stress at which cross-slip is initiated.
Dissert. Abstr.

N68-37531 Denver Univ., Colo.
RAY MEASUREMENTS OF SHOCK INDUCED STACKING FAULTS IN COPPER AND ALPHA BRASS
Hsi Shan Yu (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3295

Intrinsic stacking faults and twin faults were introduced in copper and alpha brass by shock loading. Materials investigated include copper, 85-15 brass and 70-30 brass. A mouse trap assembly was used to produce plane shock wave in the specimens using C-2 Detasheet as the high explosive. Shock pressure ranged from 45 to 165 Kbars. X-ray diffraction data were taken by fixed time step scanning. Profile analysis of the diffraction peaks was achieved by an extensive computer program in Algol. The intrinsic stacking fault probability, twin fault probability and diamond pyramid hardness number all increase with shock pressure. The fault probabilities depend not only upon their respective fault energies but also upon the mode and amount of plastic deformation. The increase in hardness with increasing shock pressure is due to the increase in the number of fine twins as well as the increase in that of dislocations. Yield strength has the general trend of increase with shock pressure as the fault probabilities while percentage elongation changes in the opposite direction. Dissert. Abstr.

N68-37566 Washington Univ., Seattle.
PHASE TRANSFORMATIONS AND METASTABLE CONSTITUTION OF TITANIUM-RICH ALLOYS OF TITANIUM AND CHROMIUM
Richard Harold Ericksen (Ph.D. Thesis) 1967 213 p refs
Available from Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-3847

The martensitic transformations that occur in bulk material and thin foils of titanium and titanium-chromium alloys containing 2.4–18.7 at. % chromium were investigated using transmission electron microscopy, optical microscopy, and X ray diffraction. The fine structure of the HCP martensite in Ti and alloys containing 2.4–5.9 at. % Cr was investigated, and the results interpreted in terms of the crystallographic theory of the martensitic transformation. The structure of the martensite in Ti was found to correspond to the type currently described as massive martensite. The crystallographic theory was found to agree with the experimental observations reported for the massive martensite in Ti if the fine structure is assumed to form as a result of accommodation slip. The habit plane, orientation relationship, and lattice correspondence for the acicular martensite that formed in titanium-chromium alloys was investigated and found to remain independent of chromium content. These results were compared to the corresponding data for titanium martensite. Dissert. Abstr.

N68-37695# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
COMPRESSIVE CREEP BEHAVIOUR OF NIOBIUM CARBIDE–GRAPHITE COMPOSITES
William F. Brizes and L. L. French 1967 22 p 11 refs
(WANL-TME-1761) CFSTI: HC $3.00/MF $0.65

The compressive creep behavior of cold pressed and sintered niobium carbide–graphite composites has been studied as a function of temperature and composition. The equation $\epsilon = A\sigma^{1.4}_{0} \exp [5.0 [(\text{volume \% porosity}/100)] + [(\text{volume \% NbC}/100)]$ is proposed to represent the creep behavior of graphite-rich composites as a function of composition and stress. The activation energy, activation volume and stress dependence of creep were determined and the possible mechanisms controlling deformation were examined. Author (NSA)

N68-37823# Stanford Research Inst., Menlo Park, Calif.
INTERACTION OF LIQUID SODIUM WITH 304 STAINLESS STEEL Final Report
John W. Moberly, Malcolm Barlow, Marvin C. Garrison, and Peter J. Planting 31 Jan. 1968 28 p 2 refs
(Contract AT(04-3)-115)
(TID-24602) CFSTI: HC $3.00/MF $0.65

The effects of liquid Na environment on 304 stainless steel are analyzed by electron microscopy. Effects of exposure time and temperature are evaluated. NSA

N68-37861# General Electric Co., Schenectady, N. Y.
FATIGUE-CRACK GROWTH RATE STUDIES OF LOW ALLOY PRESSURE-VESSEL STEELS
D. F. Mowbray, W. R. Andrews, and A. J. Brothers Feb. 1968 29 p refs Presented at the Conf. on the ASME Pressure Vessels, Piping and Petroleum Division, Dallas, Sep. 1968
(Contract W-31-109-ENG-52)
(KAPL-P-3439; CONF-680904-1) CFSTI: HC $3.00/MF $0.65

Fatigue-crack growth rates were determined at room temperature for ASTM A302–Class B and A508–Class 2 steels in two characteristic plate and forging directions. Tests were performed under zero-to-tension cyclic loading using both through-crack and part-through-crack plate specimens. Crack growth rates in the through-crack specimens, though affected by plate or forging directions, were found to correlate well upon the hypothesis that the crack extension per cycle is proportional to a positive power of the range of alternating stress intensity factor. In addition, the rate of crack extension through the plate thickness of the surface-crack specimens was successfully correlated with data from through-crack specimens. Author (NSA)

N68-37870*# North American Rockwell Corp., Los Angeles, Calif.
A CRITICAL EXAMINATION OF DISCRETE LATTICE AND DISPERSED BARRIER HARDENING
A. W. Sommer and Kanji Ono (Calif. Univ., Los Angeles) May 1968 38 p 52 refs Supported in part by NASA
(Contract N00014-67-C-0439)
(NASA-CR-97350; ONR-TR-1; AD-673545) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The paper examines two theories of thermally activated deformation of metals: i.e., the lattice (Peierls-Nabarro) and dispersed barrier hardening. The predictions of two hardening theories show considerable similarities. Only forecasts with respect to the impurity content dependence of the yield stress and activation volume are significantly different. Available data on low temperature deformation in alpha-Ti and body centered cubic metals have been considered. The presently available theories of lattice hardening cannot explain strong dependence of the yield stress of alpha-Ti and Mo on the interstitial content. In the case of other bcc metals, it is not possible to distinguish between these two types of hardening on an experimental basis. In fact, except in extremely pure materials, it is suggested that the two types of hardening may cooperate to control plastic flow. Author (TAB)

N68-37892# MSA Research Corp., Evans City, Pa.
THE EFFECT OF HIGH-TEMPERATURE SODIUM ON THE MECHANICAL PROPERTIES OF CANDIDATE ALLOYS FOR THE LMFBR PROGRAM Quarterly Progress Report, Jan.–Mar. 1968
May 1968 91 p refs
(Contract AT(11-1)-765)
(MSAR-68-77) CFSTI: HC $3.00/MF $0.65

The corrosive effects of high temperature liquid Na on structural materials for the LMFBR are analyzed. Type 304 and Type 318 stainless steel are submitted to high-O_2 and -C liquid Na at 1200 and 1400°F. The effects of the liquid Na on tensile properties of the stainless steel samples are described. Surface tension measurements for pure liquid Na are presented. NSA

N68-37909# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHASE DIAGRAM OF THE ZRC-MO SYSTEM [DIAGRAMMA SOSTOYANIYA ZRC-MO]
S. S. Ordanyan 6 Dec. 1967 14 p refs Transl. into ENGLISH from Issled. V Obl. Khim. Silikat i Okislov, Sb. Statei (USSR), 1965 p 220–228
(FTD-HT-23-1034-67; AD-674725)

To investigate the possibility of using as heat-resistant materials alloys consisting of ZrC bound by Mo, the quasi-binary section ZrC-Mo of the system Zr-C-Mo was studied. The constitutional diagram of the quasi-binary section was constructed on the basis of data obtained by chemical, x-ray diffraction, and metallographic study as well as of determinations of the temperatures of the beginning of melting. Author (TAB)

N68-37929# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
PREPARATION AND CHARACTERIZATION OF HIGH QUALITY SINGLE CRYSTAL REFRACTORY METAL CARBIDES Technical Report, Apr. 1967–Apr. 1968
J. M. Tobin and L. R. Fleischer Wright-Patterson AFB, Ohio AF Mater. Lab. May 1968 64 p refs
(Contract AF 33(615)-3982)
(AFML-TR-67-137, Pt. 2; AD-674633)

A new and generally more applicable technique for growing large single crystals of transition element carbides was developed. Crystals of a nominal 0.25-inch diameter and 1.0-inch length were obtained in yields of over fifty per cent for HfC, ZrC, TaC and alpha-Ta2C. In the previously reported technique, the crystals of ZrC were grown during the process of direct reaction of the elements using a multiple-step increased temperature heating cycle. That technique was not readily adapted to the high yield preparation of crystals of the other three carbides. The new technique starts with the preparation of fully dense carbide rod and homogenized at the highest carbon content attainable for the carbide. The rods are given a critical strain in axial compression at very high temperatures. Subsequent annealing at a higher recrystallization temperature causes the growth of very large grains. The growth of the grains to full rod diameter and length occurs during isothermal annealing by means of solid state grain boundary movements under the influence of the strain energy absorbed by the carbides. Such grains have been shown to be single crystals of a high degree of crystalline perfection, free of strain and homogeneous. Author (TAB)

N68-38016# Brown Univ., Providence, R. I. Div. of Engineering.
PLASTIC DEFORMATION IN BRITTLE AND DUCTILE FRACTURE
D. C. Drucker and J. R. Rice Jul. 1968 56p refs Presented at the Natl. Conf. on Fracture Mech., Bethlehem, Pa., Jun. 1967
(Contract ARPA SD-86)
(AD-674852) CFSTI: HC $3.00/MF $0.65

An affort is made to cover the full elastic-plastic range from fractures which initiate and propagate at nominal or net stress in the elastic range to the fractures at fully plastic or limit load conditions. Similarities and differences of behavior between steels which are highly rate-sensitive and aluminum alloys or other rather insensitive materials are examined. A demonstration is given of the likelihood of confusing limit load fractures with low stress fractures. Author (TAB)

N68-38049# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ADHESION INTERACTION IN A VACUUM OF REFRACTORY METALS, METAL-LIKE COMPOUNDS AND HARD ALLOYS [ADGEZIONNOE VZAIMODEISTVIE V VAKUUME TUGOPLAVKIKM METALLOY, METALLOPODOBNYKH SOEDINENII I TVERDYKH SPLAVOV
A. P. Semanov Dec. 1967 19 p refs Transl. into ENGLISH from Mashinostr. (Kiev), no. 1, 1967 p 116–127
(FTD-MT-24-347-67; AD-674694)

Pairs of similar and dissimilar metals were formed by bringing into contact specimens of Ti, Zr, Nb, Ta, Mo, W and Co under a load of 4-5 kg in a vacuum of 0.0001-0.00001 mm Hg at temperatures up to 0.7 T sub mel (T sub mel is the melting temperature of the low-melting component of the pair). The paired specimens contacting each other at their end faces were held under the load for 3 min and then pulled apart to determine the adhesion interaction between them. The ratio of the applied load to the force required to break the joint, tentatively designated the adhesion coefficient, was used as the criterion of the adhesion capacity of the tested materials. Similar tests were also made on specimens of TiC, VC, Cr3C2, NbC, Mo2C, WC, and CrB sintered carbides and borides and also on specimens of VK-8B, VK-11B, VK-15, and VK-15M sintered tungsten carbide-base hard alloys. All tested combinations of similar and dissimilar materials at definite temperatures exhibited adhesion interaction in vacuum, which appeared to be a common phenomenon for all crystalline solid bodies. Adhesion interaction of similar pure metals began in the 0.3-0.4 T sub mel range; dissimilar pure metals began to interact in the 0.35-0.45 T sub mel range. The adhesion interaction of similar pure metals was found to depend on their electron structure. Author (TAB)

N68-38056# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
THE OXIDATION AND CONTAMINATION OF TITANIUM AND ITS ALLOYS
J. M. Ferguson 1 Jul. 1968 19 p refs
(Contract F33615-68-C-1325)
(DMIC-MEMO-238; AD-674607) CFSTI: HC $3.00/MF $0.65

Experimental programs concerned with the oxidation of titanium and its alloys are reviewed and results compared with those predicted by theory. Wagner-Hauffe theory is used as the primary basis for comparison, and its inconsistencies are pointed out. Fifteen binary alloy systems involving titanium are covered, as well as a few ternary and commercial alloys. A short section discusses the effects of oxygen or nitrogen contamination on the mechanical properties of titanium and its alloys. Author (TAB)

N68-38089# Joint Publications Research Service, Washington, D. C.
THERMOMECHANICAL TREATMENT OF VARIOUS STEEL PRODUCTS DESCRIBED
3 Oct. 1968 109 p refs Transl. into ENGLISH from various RUSSIAN articles
(JPRS-46592) CFSTI: HC $3.00/MF $0.65

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12. HEAT AND THERMOMECHANICAL TREATMENT OF ROLLED STOCK ON METALLURGICAL PLANT'S PRODUCTION LINE K. F. Starodybov p 91–94

N68-38090# Joint Publications Research Service, Washington, D. C.
TOUGHENING AUSTENITIC MANGANESE STEEL BY HEAT AND THERMOMECHANICAL TREATMENTS
V. I. Grigorkin et al *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 1–9 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 4, 1967 p 110–115 (See N68-38089 24-17)

The feasibility of augmenting hardness and strength of austenitic manganese steels through heat and thermomechanical treatment was examined. Observed were mechanical properties as a function of high-temperature thermomechanical treatment and the minimum temperature required for the termination of rolling at which the separation of the carbides along the austenite grain boundaries occurs. Heating of steel bars to 1100°C for one hour with subsequent transfer to a 900°C or 800°C salt bath, or heating to 850°C in a salt bath for 45 minutes raised the steel's yield point 40 to 50% and increased hardness from 200 to about 330 Vickers. The temperature at termination of rolling should not be below 800° to 850°C for a successful toughening treatment. G.G.

N68-38091# Joint Publications Research Service, Washington, D. C.

RECRYSTALLIZATION OF CHROME STEELS UNDER CONDITIONS OF HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT

M. L. Bernshteyn et al *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 10–17 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 3, 1966 p 140–144 (See N68-38089 24-17)

Recrystallization of deformed austenite chrome steel microstructures by high temperature thermomechanical treatment cycles to temperatures in the γ-phase stability region and subsequent deformation rolling with 50% reduction in area was analyzed. Steels most resistant to recrystallization were those with a content of 0.2% C and 3, 5, 9, and 12% Cr as well as those with a content of 0.3% C and 5% Cr and those with 0.8C and 12% Cr. G.G.

N68-38093# Joint Publications Research Service, Washington, D. C.

AUGMENTING STEEL'S STRENGTH BY THERMOMECHANICAL TREATMENT

G. Rassmann et al *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 45–58 refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 12, 1967 p 30–37 (See N68-38089 24-17)

The effects of chemical composition in iron-nickel alloys and in chrome steels on austenitic deformation, carbon content, and tempering temperature necessary for thermomechanical treatment hardening were studied. It was observed that the effectiveness of the thermomechanical treatment depended upon the presence and state of the retained austenite. The quantity of the retained austenite in iron nickel alloys and its strain hardening depended upon the deformation and carbon content, which in turn defined the effect of raising the strength through thermomechanical processes. G.G.

N68-38094# Joint Publications Research Service, Washington, D. C.

FAILURE OF Cr-Ni STEEL SUBJECTED TO THERMOMECHANICAL TREATMENT

V. I. Kumanin *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 59–65 refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no 8 1967 p 37–40 (See N68-38089 24-17)

Crack initiation and crack propagation energies in chromium nickel steel subjected to different thermomechanical cycles are evaluated by tensile testing of 5 mm-diameter steel specimens. Electron fractographic analyses of grain specific surface per unit of volume and distortion of the martensite crystal lattice showed that recrystallization substantially increased crack propagation energy and lessened the steel's tendency to brittle fracture. Temper at 100 and 200°C increased crack origination and propagation energies with a simultaneous drop in strength characteristics. G.G.

N68-38095# Joint Publications Research Service, Washington, D. C.

INFLUENCE OF THERMOMECHANICAL TREATMENT ON STRUCTURE AND PROPERTIES OF 40KhNMA AND 30KhGSA STEELS

V. N. Danilov et al *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 66–73 ref Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 12, 1967 p 40–43 (See N68-38089 24-17)

Strain rate effects during high temperature thermomechanical treatment on structure and mechanical properties of 40 KhNMA and 30 KhGSA steels were studied. Forged steel bars were heated to 1100°C, precooled in air down to 950°C, forged and oil quenched. Structural analyses of tempered samples showed that the high temperature thermochemical treatment refined the steel's grain and altered its shape; the grain boundaries assumed large curvature and length. Thermomechanical treatment at higher tempering temperatures toughened the steel and retained its polymorphous transformations. G.G.

N68-38096# Joint Publications Research Service, Washington, D. C.

EFFECT OF HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT (INDUCTION HEATING) ON PROPERTIES OF SPRING STEEL

O. I. Shavrin *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 74–78 Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 12, 1967 p 59–60 (See N68-38089 24-17)

A high temperature thermomechanical treatment which combined induction heating and deformation by helical rolling raised steel strength markedly through improving plasticity and decreasing crack forming susceptibility. Plasticity increased so much that the steel after a 200 to 300°C temper already satisfied the requirements imposed on spring steels. G.G.

N68-38097# Joint Publications Research Service, Washington, D. C.

THERMOMECHANICAL TREATMENT OF TOOL STEELS

Y. Michev et al *In its* Thermomech. Treat. of Various Steel Prod. Described 3 Oct. 1968 p 79–80 refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 9, 1967 p 10–15 (See N68-38089 24-17)

An investigation of the cutting properties of high speed steels as a function of deformation in low temperature thermomechanical treatment demonstrates a correlation between the quantity of retained austenite and cutting properties. The more martensite formed during primary hardening, the higher are its heat-resistance and cutting properties. The martensite contained during secondary hardening contains less carbon and alloying elements. G.G.

N68-38171# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.

TANKAGE MATERIALS IN LIQUID PROPELLANTS Final Report, 1 Jun. 1967–1 Jun. 1968

S. M. Toy, L. E. Bell, W. D. English, and N. A. Tiner Jul. 1968 120 p refs

(Contract F33615-67-C-1718)

(DAC-59868-F1; AFML-TR-68-204; AD-674603) CFSTI: HC $3.00/MF$0.65

The report discusses the work conducted on Air Force Contract F33615-67-C-1718 concerning the study of engineering behavior of tankage materials in liquid propellants. A survey of literature about the type and form of impact data required by tank designers was made. Modified ABMA open-cup impact tests on Al 2014-T6 and Ti-6Al-4V (ELI) in the oxidizers N_2O_4, ClF_5, and LF_2 were conducted. Author (TAB)

N68-38216# Martin Co., Baltimore, Md. RIAS Div.
EFFECTS OF ENVIRONMENT ON THE FRACTURE BEHAVIOR OF TITANIUM AND ITS ALLOYS Final Report
A. J. Sedriks and E. N. Pugh Watertown, Mass. Army Mater. and Mech. Res. Center Aug. 1968 28 p refs
(Contract DAAG46-67-C-0138(X))
(RIAS-TR-68-11c; AMMRC-CR-68-01(F); AD-674255) CFSTI: HC $3.00/MF $0.65

A study was made of the mechanisms of stress-corrosion cracking (SCC) of titanium and Ti-Al alloys in methanol-iodine solutions. The path of cracking was found to depend on the composition of the alloy. In pure titanium and a Ti-2.09 w/o Al alloy SCC is intergranular. In higher alloys (> 5 w/o Al) only the initial part of the crack is intergranular, the later formed transgranular propagation stage exhibiting cleavage markings. Comparative studies of corrosion behavior, characteristics of SCC, and metallurgical factors (i.e. alloy composition and deformation characteristics) indicated that two mechanisms may be operative. The intergranular SCC process appears to involve stress-accelerated corrosion, while the transgranular process exhibits the characteristics of cleavage and appears to be related to a reduced propensity for cross-slip. Comparison of the SCC behavior in methanol-iodine solutions with that in a methanol-hydrochloric acid solution indicates that similar processes are operative in the latter solution. Author (TAB)

N68-38231# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
A REVIEW OF METALLOGRAPHIC PREPARATION PROCEDURES FOR BERYLLIUM AND BERYLLIUM ALLOYS
C. W. Price and J. L. McCall 1 Jun. 1968 20 p refs
(Contract F33615-68-C-1325)
(DMIC-MEMO-237; AD-674066) CFSTI: HC $3.00/MF $0.65

The Memorandum is divided into four topics: (1) Grinding, (2) Polishing, (3) Etching, and (4) Thining for transmission electron microscopy. Procedures reviewed are also listed in tabular form for ready reference. In addition to reviewing published references, the authors have included a considerable amount of previously unpublished data based on their own experience and private communication with associates in the field. Author (TAB)

N68-38344# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MICROPROBE DETERMINATION OF THE $\alpha/(\alpha+\beta)$ BOUNDARY FOR THE Zr-Nb SYSTEM
I. T. Bethune and C. D. Williams Jul. 1968 18 p refs
(AECL-2715) Available from Atomic Energy of Can., Ltd., Chalk River: $0.50

Electron probe microanalysis has been used to locate the position of the $\alpha/(\alpha+\beta)$ boundary in the Zr-Nb phase diagram by measuring the phase compositions in specimens of a Zr-2.5 wt.% Nb-0.12 wt% O alloy annealed at temperatures in the range 800–850°C. The solubility of Nb in α-Zr at 800°C is shown to be 1.1 ± 0.1 wt.%. The concentration of Nb in the α-phase annealed for short intervals at 850°C is also close to 1%, decreasing to 0.85 ± 0.05 wt.% with prolonged annealing at this temperature. A precise determination of the $(\alpha+\beta)/\beta$ boundary has not been made; extrapolation of non-equilibrium compositions indicate that the monotectoid composition is close to 20 wt.% Nb, as shown in earlier phase diagram work. Author

N68-38346# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
SURFACE TREATMENTS TO IMPROVE THE WEAR RESISTANCE OF TYPE 304 STAINLESS STEEL IN WATER
O. Ogunlade and R. D. Watson Aug. 1968 23 p refs
(AECL-2732) Available from Atomic Energy of Can., Ltd., Chalk River: $1.00

Various surface treatments were applied to 304 stainless steel journals in an attempt to improve their wear resistance. The treatments consisted of one or more of the following: shot-blasting with Glas-shot or chilled-iron-shot, heating in air, in argon containing air or in vacuum. The treated journals were tested against Waukesha 88 bearings at loads of 20, 40 and 60 lb and speeds of 40 and 180 rev/min, in 80°F pH 7 water. Representative specimens of the various treatments were metallographically examined to determine the nature of the surface. In general, treated journals had much better wear resistance than untreated journals. The improvement was believed to be due mainly to surface oxidation. The best surface treatment consisted of Glas-shot blasting the surface followed by heating in air at 800°C for 21 h. Author

N68-38347# National Research Council of Canada, Ottawa (Ontario).
X-RAY ANALYSIS OF THE DIMENSIONS OF BLOCKS IN CAST MONOCRYSTALS OF ALUMINIUM
D. E. Ovsienko and E. I. Sosnina 1968 16 p refs Transl. into ENGLISH from Fiz. Metalloved. (USSR), v. 3, no. 3, 1956 p 516–526
(NRC-TT-1330) CFSTI: HC $3.00/MF $0.65

The possibility is considered of applying the X-ray method in determining the dimension of blocks of 10^{-4}–10^{-2} cm in crystals possessing primary and secondary extinction. A convenient expression for comparison with experimental results is obtained for the integral intensity of reflection from a monocrystal. An estimate of the dimensions of blocks in cast monocrystals of aluminium is given. It is shown that the size of the block decreases with increasing growth rate of the crystal. Author

N68-38359# Naval Research Lab., Washington, D. C.
ANALYSIS OF CRACKING IN SWAGED 7075-T6 ALUMINUM ALLOY TUBING
E. P. Dahlberg Jun. 1968 19 p
(NRL-MR-1894; AD-673954)

Cracks at the ends of two tapered swaged 7075-T6 aluminum alloy support struts were identified as intergranular fractures by electron microscopy indicating that failure occurred by a stress-corrosion mechanism. In further support of this conclusion, microstructural examination showed that a significant short-transverse type grain orientation existed in the fracture plane. Author (TAB)

N68-38461# Idaho Nuclear Corp., Idaho Falls.
EFFECT OF IRRADIATION ON THE SURFACE ACTIVITY AND DIFFUSIVITY OF HYDROGEN IN STEELS
C. R. Brinkman and J. M. Beeston Jun. 1968 14 p refs
(Contract AT(10-1)-1230)
(IN-1200) CFSTI: HC $3.00/MF $0.65

As a prerequisite to determining the combined effects of irradiation and hydrogen content upon the mechanical properties of ASTM A542, A302B, and HY 80 pressure vessel steels, the cathodically induced hydrogen occlusion was studied. The rate of occlusion increased with increasing current density, poison concentration (sodium arsenate or carbon disulfide), and irradiation. The induction period was reduced by increased current density and irradiation. Specimens were irradiated to 4×10^{17} n/cm^2 (E>1 MeV) and the radioactivity measured 2 to 3 r/hr at contact prior to testing. Increasing the poison concentration and irradiation also resulted in an increase in the apparent "supersaturation" solubility. The increased occlusion rates found with the irradiated specimens were attributed to either changes in the specific rate constants for absorption and desorption or the number of surface active sites. The increased apparent solubility limit was attributed to increased hydrogen trapping. Author (NSA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-37504 Colorado Univ., Boulder.
THE EFFECT ON REACTION MODE ON THE DEVELOPMENT OF PORE STRUCTURE IN ACTIVE CARBON
Stephen Michael Fass (Ph.D. Thesis) 1967 153 p
Available from Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-2646

Studied is the relationship between reaction mode and pore structure development during the reaction between a porous carbon and gaseous carbon dioxide. The carbon, a devolatilized and heat-treated coal, was reacted to various extents with carbon dioxide under conditions of apparent surface reaction rate limitation (800°C) and of pore diffusion rate limitation (900°C). The pore structures of both the unreacted and reacted carbons were studied by two means; macropores (larger than 200 Å radius) were determined with a mercury porosimeter, and micropores (from 10 Å radius to 200 Å radius) were measured by analysis of nitrogen adsorption isotherms. Pore size analyses showed that 800°C macropores were enlarged during burnoff, but micropore volume decreased. At 900°C, on the other hand, both macropore and micropore volume increased during burnoff, until extreme burnoffs, at which particle size began to decrease, destroying all pores. A model was proposed to explain this behavior. Essentially, it was theoretized that at 800°C macropores were burning under reaction limitation, but micropores were in a diffusion-limited condition. Thus macropore growth obliterated micropores, while few new micropores were formed. At 900°C, both types of pores reacted under diffusion limitation, and micropore growth could be observed.
Dissert. Abstr.

N68-37513 Ohio State Univ., Columbus.
INFLUENCE OF LOCALIZED MATRIX RECRYSTALLIZATION ON THE STRENGTH OF TRIAXIAL CERAMICS
Charles Clifford Fain (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-2980

The influence of compositional substitutions in a typical triaxial ceramic was investigated by microstructural and other analytical techniques. It was found that localized matrix recrystallization through the use of minor quantities of magnesium carbonate-zircon and forsterite substitutions were the most beneficial. Mechanical strength improvements of 50% were obtained for dry-processed low-pressure formed specimens. Modification of the free quartz grain size in these compositions was capable of producing additional benefits such that 62% strength improvements were obtained. Changes in the raw material processing and specimen size produced 80% strength improvements. Matrix crystals were believed to be cordierite and a mechanism of their formation is suggested. Forsterite, either formed from magnesia-zircon reactions or added alone, first became part of the localized glassy matrix thereby taking quartz into solution.
Dissert. Abstr.

N68-37524 Minnesota Univ., Minneapolis.
COMMINUTION OF PARTICULATES BY THE MECHANISM OF IMPACTION
Andrew Russel McFarland (Ph.D. Thesis) 1967 209 p
Available from Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-1606

The purpose is to investigate the breakage characteristics that are associated with high velocity impaction of particles, namely, the proportion of particles that undergo fracture and the post-impaction size distribution. Here feed particles possessing an initially narrow sieve fraction are aerodynamically accelerated and impinged against a solid anvil. The fragments are sieved to remove particles of the original size and a comparison is made between the masses of size-reduced particles and original particles. This procedure yields data for the probability of fracture. Next the size distribution of the fragments is obtained using a combination of sieving and sedimentation techniques. Distributions obtained from the two techniques are matched using experimentally derived correlation factors. Since sieving is the most common technique for analyzing the size distribution of powders, final data are presented on a basis of equivalent sieve size.
Dissert. Abstr

N68-37550 Stanford Univ., Calif.
THE THERMODYNAMICS OF POLYMER SOLUTIONS
Bruce Edward Eichinger (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17417

An investigation of the literature has shown that the experimental data are, for the most part, neither complete nor accurate. The more reliable results suggested that complimentary experiments on the systems (1) natural rubber-benzene, (2) polyisobutylene (PIB)-benzene, (3) PIB-cyclohexane, and (4) PIB-n-pentane would afford valuable comparisons with theory. The techniques of high pressure osmometry, vapor sorption, and volume change dilatometry have been improved in order to supply data of the required accuracy on these four mixtures. Activities and volume changes have been measured for system (1) over the entire range of composition. Similar measurements on system (2) have also been performed. Excess volumes and activities measured for mixture (3) are also compared with theory. Comparison of systems (1), (2), and (3) indicates that the entropy requires corrections that are inconsistent with the tenets of refined calculations based on the lattice model. Activities of (4) measured by vapor sorption show the free energy parameter to be more concentration dependent than was thought. No evidence is obtained to support the contention that either natural rubber or polyisobutylene contain vestiges of crystalline order at room temperature. Experimental results obtained here suggest that previous experiments on (1) and (2) yielding partial molar entropies larger than the lattice model theory predicts are in error.
Dissert. Abstr

N68-37756# Forest Products Lab., Madison, Wis.
FLUORESCENCE MICROSCOPY FOR DETECTING ADHESIVES ON FRACTURE SURFACES
John T. Quirk Apr. 1968 2 p
(FPL-0191; AD-668837)

When wood-adhesive joints fail it is sometimes difficult or almost impossible to judge whether failure is in adhesion or in cohesion. Failure in adhesion implies separation between the adhesive film and the wood substrate. Failure in cohesion implies that separation occurs within the wood specimen or within the glue film; thus it is necessary to assess the location and type of failure. It is particularly important to be able to detect the presence of very thin films of adhesive on the wood surface. Several survey methods using a compound research microscope and various staining techniques were investigated to select an applicable method for detecting these films. Fluorescence microscopy utilizing ultraviolet (UV) radiation proved to be the fastest and most efficient way of examining surfaces for location of fracture.
Author (TAB)

N68-37764 Virginia Univ., Charlottesville.
DIFFUSION IN POLYMERIC SOLUTIONS
Sik U Li (Ph.D. Thesis) 1967 179 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-3151

In this work, an expression was developed to explain the phenomena of increasing (or decreasing) diffusion coefficients in polymeric solutions. This expression, together with heat of mixing and viscosity data, can be used to predict the diffusion coefficient in polymeric solutions in terms of that for the pure solvent case. In addition, a semi-empirical expression for the prediction of the heat of mixing for polymer molecules and solvent was derived. New diffusion coefficient data needed for the testing of the proposed expression were measured using the microinterferometric method. A total of seven polymeric systems were employed in this investigation; polymer concentration in the solutions ranges up to 40% by weight. Diffusion coefficient data were estimated to have an error of ±12% which are within the range of analytical error. Dissert. Abstr.

N68-37936*# Minnesota Univ., Minneapolis.
THE DYNAMIC STRESS-STRAIN BEHAVIOR OF PARACHUTE CLOTH
H. D. Melzig Dec. 1967 53 p refs
(Contract NAS9-7069)
(NASA-CR-92353; MC-67-121) CFSTI: HC $3.00/MF $0.65
CSCL 11E

The stress-strain behavior of parachute cloth, MIL-C-7020, I, was measured for different rates of load increase (1–450 lbs/sec), at creep conditions (70–95% of nominal breaking load), and at fatigue tests under a sinusoidal load (0.1–60 cps, different amplitudes and upper load limits). The machine used and test procedure is described and explained in detail. Test results are given in list and graphical form to show the decrease in strength under dynamic loading conditions. Author

N68-37945*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MELTING RELATIONSHIPS IN THE SYSTEM SODIUM ALUMINUM SILICON OXIDE-SODIUM CHLORIDE WATER AT 1 KILOBAR PRESSURE
A. F. Koster van Groos and P. J. Wyllie (Chicago Univ.) 1968 61 p refs Sponsored in part by NSF
(NASA-TM-X-63372; X-644-68-395) CFSTI: HC $3.00/MF $0.65
CSCL 11B

Phase relationships in the system $NaAlSi_3O_8$–NaCl–H_2O are determined between 850°C and 950°C at 1 kilobar pressure; they appear to be ternary. In the bounding system NaCl–H_2O, a two phase field containing NaCl rich liquid and H_2O rich vapor is intersected at the temperature range of this investigation. This two phase field must extend into the ternary system; however, the phase relationships in the ternary system are very simple and appear not affected by the presence of this field. In the bounding system $NaAlSi_3O_8$–H_2O a wide miscibility gap occurs between liquid and vapor; in the system $NaAlSi_3O_8$–NaCl a wide miscibility gap extends between silicate rich liquid and NaCl rich liquid at temperatures in excess of 1100°C and at 1 bar pressure. Both miscibility gaps are connected through the ternary system separating a silicate liquid from a fluid phase with a composition close to the system NaCl–H_2O and containing a small, unknown proportion of dissolved silicates. A temperature minimum is present on the ternary liquidus at 873±5°C on a colinear three phase equilibrium, representing a reaction which is isobaric invariant by restriction: Albit + Vapor (H_2O–NaCl) → $Liquid_{Albite}$ Author

N68-37963# Royal Aircraft Establishment, Farnborough (England).
STUDIES ON THE CARBONIZATION OF POLYACRYLONITRILE FIBRE. PART 1: CHANGES IN MECHANICAL PROPERTIES WITH HEAT TREATMENT
Kazuo Miyamichi Jun. 1968 11 p refs Transl. into ENGLISH from Sen-I Gakkaishi (Japan), v. 21, no. 12, 1965 p 635–639
(RAE-LIB-TRANS-1306) CFSTI: HC $3.00/MF $0.65

Fibers and fabrics of polyacrylonitrile, flame proofed by oxidation in air at 300°C, were heated in nitrogen at various temperatures up to 1000°C and weight losses, shrinkages, and mechanical properties were measured. Weight losses and shrinkages increased 60 to 70% and 13 to 20% respectively with both fibers and fabrics as the heat treatment temperature was raised to 1000°C. The tensile strength and Young's modulus of single fibers increased and the elongation to fracture decreased with the temperature of heat treatment, fibers that had been treated to 1000°C having a strength of about 100×10^3 lb/in^2, a modulus of 5×10^6 lb/in^2 and an elongation of 2%. The strengths of spun yarn and fabrics on the other hand decreased as the heat treatment temperature was raised probably due to the lowering of the resistance of the fibers to shearing forces and to their reduced elongation to fracture. Maximum abrasion resistance was found following a heat treatment to 500°C. Author

N68-37997# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.
DIRECT BASAL-PLANE SHEAR IN SINGLE CRYSTAL GRAPHITE
D. E. Soule and C. W. Nezbeda (Union Carbide Corp., Parma, Ohio) Jul. 1968 78 p refs *Its* Res. Commun. 68
(Douglas Paper-5139; AD-674747)

The paper consists of an analysis of the overall stress-strain behavior of single crystals and, to a lesser extent, of pyrolytic graphite. In the order of increasing applied stress are presented the shear modulus G, the low critical resolved shear stress sigma sub c, the observations of creep and extreme glissile slip, and finally shear fracture and the effect of cyclic shearing on shear strength sigma sub s. The type and effect of bulk lattice imperfections, such as twins and delamination voids, are investigated. Correlations are made between the change in the observed G and the concentration of dislocations and bulk lattice imperfections. The average dislocation line segment length l and density N sub D are calculated from the observed sigma sub c and change in G. Attempts to circumvent the influence of dislocations by pinning or frequency damping are considered. One of these, the pinning of dislocations by boron ions, is observed here directly to be very effective in increasing G, approaching asymptotically the intrinsic lattice value G sub o. Author (TAB)

N68-37998# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE CALCULATION ON NON-STEADY STATE FUSION OF VITREOUS MATERIALS [PRIBLIZHENNYI RASCHET NESTATSIONARNOGO OPLAVLENIYA STEKLOVIDNYKH MATERIALOV]
S. K. Matveyev 4 Dec. 1967 11 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 11, no. 6, 1966 p 730–736
(FTD-HT-23-791-67; AD-674669) CFSTI: HC $3.00/MF $0.65

The problem of unsteady ablation of glassy materials subjected to aerodynamic heating is considered. An approximate integral method is outlined for calculating the significant ablation parameters. The method is applied to determining heat transfer rates and surface temperature at the stagnation point of a blunted body. The differential equation derived from the equation of conservation of energy is used to calculate the surface temperature of the melted film. A comparison of the numerical results obtained by this method with the exact solution shows satisfactory agreement. It is said that this method may be used when similar solutions are not valid and successfully applied to calculations of unsteady melting of a glass shield not only in the stagnation region, but also on the surface of the body. Author (TAB)

N68-38124# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
MECHANICAL BEHAVIOR OF BERYLLIUM WIRE REINFORCED PLASTIC COMPOSITES. PART 2: TIME DEPENDENT MECHANICAL PROPERTIES Technical Report, Sep. 1966–Oct. 1967

H. S. Schwartz and W. Mahieu Jun. 1968 40 p refs
(AFML-TR-66-404, Pt. 2; AD-674591) CFSTI: HC $3.00/MF $0.65

The dependence of the mechanical behavior of beryllium wire reinforced plastic composites on duration of load (creep and stress-rupture), number of loading cycles (fatigue), and vibrational frequency (dynamic modulus and damping) was investigated. Where possible, this behavior is compared with that of the constituent beryllium wire and other structural materials. The stress at which plastic deformation commences (elastic limit) in beryllium wire was determined. The static mechanical properties of beryllium wire which had been acid etched to achieve a smooth surface were determined and were compared with similar properties of as received beryllium wire. Author (TAB)

N68-38305# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MODEL FOR THE DETERMINATION OF THERMOELASTIC CHARACTERISTICS FOR MATERIALS REINFORCED WITH FIBERS [OB ODNOI MODELI DLYA OPREDELENIYA TERMOUPRUGIKH KHARAKTERISTIK MATERIALOV, ARMIROVANNYKH VOLOKNAMI]
A. A. Kilchinskii 18 Sep. 1967 19 p refs Transl. into ENGLISH Prikl. Mekh., Akad Nauk UKR RSR (Kiev), v. 1, no. 12, 1965 p 65–74
(FTD-HT-67-422; AD-674158) CFSTI: HC $3.00/MF $0.65

An approximate method is discussed for the determination of cited elastic and thermal characteristics of materials reinforced with fibers. A model is proposed for the determination of mean stresses. The method makes it possible to determine approximate values for the cited characteristics and mean stresses for each of the components of the composition material, rather than the boundaries of change. The expressions for the cited characteristics are derived in closed form. This method makes it possible to determine the indicated quantities with defining the stressed state of the material. Author (TAB)

N68-38352 Ministry of Technology, London (England).
INVESTIGATION OF THE CHANGE IN PROPERTIES OF POLYMETHYLMETHACRYLATE TRANSPARENCIES UNDER THE ACTION OF ULTRA-VIOLET IRRADIATION, VACUUM AND TEMPERATURE
E. G. Sentyurin and E. S Osikina 1968 8 p refs Transl. into ENGLISH from Fiz.-Khim. Mekh. Mater. (USSR), v. 3, no. 1, 1967 p 37–41
(Mintech-T-5766) CFSTI: $3.00

UV irradiation of 14 milliwatt/cm^2 damages the perspex surface and impairs the optical properties. Ageing in air and in vacuo at 80°C does not affect strength but specific elongation may be reduced. The strength/radiation time relationships show the advantage of orientated perspex over the random form. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-37425 Case Western Reserve Univ., Cleveland, Ohio.
CONCERNING THE RELATIONSHIP BETWEEN SPACE-TIME DISTANCE AND THE CONSERVATION OF ENERGY-MOMENTUM
Carlos Martin Pereira (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-3321

The mathematical structure of Einstein's gravitational field equations is examined. Riquier's existence theorem is applied to these field equations to derive their integrability conditions in the analytic non-vacuum case. The integrability conditions which must be satisfied by the energy–momentum tensor density, are shown to be the vanishing of the antisymmetric part of this tensor density, and the law of conservation of energy–momentum. The mathematical meaning of the law of conservation is examined. A distinction is made between the intrinsic properties and the nonintrinsic properties of the metric tensor. It is shown that given any analytic symmetric contravariant energy–momentum tensor density, a solution to the gravitational field equations always exists. Furthermore, this solution is such that the law of conservation of energy–momentum is satisfied. Both the geodesic nature of the trajectories of free particles, and the unit magnitude of the velocity 4-vector are discussed. Dissert. Abstr.

N68-37430 Ohio State Univ., Columbus.
VIBRATION OF THE RECTANGULAR PARALLELEPIPED WITH TRACTION FREE BOUNDARY
Joseph Archibald Fromme (Ph.D. Thesis) 1967 240 p
Available from Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-2982

A classical problem of the theory of elasticity which has remained unsolved for over a century is that of the free vibration of a rectangular parallelepiped with traction free boundary. The objective of this study has been to solve the problem at least in principle and preferably to the extent of providing numerical results. An infinite matrix eigenvalue problem has been derived which contains the complete eigenspectrum and which is numerically solvable. The eigensolutions to the parallelepiped problem do not satisfy sufficient conditions for their triple Fourier series to be termwise differentiable or pointwise convergent on the boundary. The method of associated periodicity, developed to overcome this difficulty is applied to several simpler problems as well as to the parallelepiped problem. A characteristic feature of these types of Fourier solution is the occurrence of an infinite matrix eigenvalue problem which uncouples into infinitely many finite problems when the eigenfunctions' Fourier series are appropriately termwise differentiable and pointwise convergent. Dissert. Abstr.

N68-37436 Utah Univ., Salt Lake City.
OPTIMIZATION OF ENGINEERING TEST DESIGN USING STATISTICAL TECHNIQUES
Gary Reed Merchant (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17385

A method of optimizing test design is developed from the basic principles of mathematics and statistics. This method of optimizing test design is easy and straightforward to apply to any system for which the mathematical model is known or can be determined. The approach by which test design is optimized is to minimize the error that results when the system parameters are estimated. This error, called propagation error, is propagated from measurement errors which occur when observations are made on a system. A numerical technique, which takes advantage of the speed of a digital computer, is presented. This technique, called the State Space Search Technique, uses an iterative process to search for the optimum test design of a given system. Examples are presented which clearly illustrate the advantages of optimum test design over other test design techniques. Dissert. Abstr.

N68-37464 Maryland Univ., College Park.
STATISTICAL TESTS FOR SIGNAL DETECTION
James Constantine Morakis (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-5375

Some of the problems arising from maximum likelihood decision systems in time varying channels, such as in the case of a spacecraft whose distance from the receiving station is

continuously changing, are solved by first introducing some simple but powerful statistics which are functions of the outputs of the correlators of an n-ary detection system. Methods are developed that (1) attach a confidence level to each decision in a maximum likelihood decision system, (2) define the critical region in a decision scheme which is restricted by conditions on the maximum error rate or minimum correct decision rate, and (3) define the critical region for an optimum generalized decision system. The six statistics that are investigated are simple functions of the largest correlator output and two other parameters. The parameters are the mean, the standard deviation, the sample mean, the sample variance, the next to the largest correlator output and the smallest correlator output. Some of the resulting statistics are completely independent of the mean, variance, sample mean or sample variance, thus avoiding dangerous assumptions about the noise power level. Dissert. Abstr.

N68-37471 Colorado Univ., Boulder.
MATRIX FLOW GRAPHS AND APPLICATIONS
Thomas Edward Kirchgessner (Ph.D. Thesis) 1967 100 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2662

The use of mathematical induction and the final algorithms for solving series loop matrix flow graphs are given in simple formulas similar to the formula for solving flow graphs characterized by scalars. The final algorithms have been given the name matrix loop rule. With the help of the matrix loop rule, systems of equations of the type XA = B, where A is tri-diagonally banded with respect to its submatrices after suitable partitioning, are solved under certain restrictions regarding submatrix nonsingularity. The general structural problem without sideway, is formulated using a relaxation approach which introduces distribution and carry-over matrices. It shows that the structure's mathematical description is isomorphic to a series loop matrix flow graph. The matrix flow graph is then solved using the matrix loop rule. Dissert. Abstr.

N68-37477# Brookhaven National Lab., Upton, N. Y.
BASIC STATISTICS FOR PHYSICISTS
B. R. Martin Jun 1968 162 p 14 refs Supported in part by AEC
(BNL-12602) CSFTI: HC $3.00/MF $0.65

Topics included in the discussion are: (1) probability theory, (2) population parameters, (3) theoretical distributions, (4) sampling, (5) estimation, (6) confidence intervals and regions, and (7) hypothesis testing. NSA

N68-37489 Virginia Univ., Charlottesville.
SYNTHESIS OF THREE DIMENSIONAL FOUR BAR LINKAGE
Herbert Graham Tull, III (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-3153

A synthesis technique applicable to the three dimensional mechanisms of the RRGG type to generate specified arbitrary space curves is presented. Specified points which define the curve are to be "occupied" at specific crank rotation with respect to an arbitrary reference angle. Synthesis is by use of a new steepest descent method converging from any starting approximation (even a very poor one) to a local minimum of the sum of the squares of the errors. Dissert. Abstr.

N68-37500 Northwestern Univ., Evanston, Ill.
SYNTHESIS OF LINEAR PATTERN CLASSIFIERS FOR PROBABILISTIC PATTERN CLASSES
Ping-Chien Chuang (Ph.D. Thesis) 1967 61 p
Available from Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-3164

Given a tolerable error rate, the sufficient condition for the existence of a linear two-category pattern classifier is found. An upper bound for the distance between means of two pattern classes on the real line is found for a linear pattern classifier based on the mean-square error criterion, when the two pattern classes have the normal distributions with the same covariance matrices. It is shown that this distance is the only parameter required to characterize the quality of the pattern classifier. The mean-square error criterion for two-category case is extended to the multicategory case by constructing a set of reference points in high dimension space. Bounds for the least mean-square error of a linear multicategory pattern classifier are found. Numerical examples are provided to gauge the quality of the pattern classifiers based on the mean-square error criterion and comparison is made with those of Bayes optimal classifiers. Dissert. Abstr.

N68-37557 Maryland Univ., College Park.
UNIQUENESS OF THE SOLUTION OF SOME HYPERBOLIC BOUNDARY VALUE PROBLEMS
Ali Ishaq Abdul-Latif (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-3331

The Dirichlet, Neumann, and some mixed Dirichlet–Neumann problems are treated for the equation $u_{xx}-u_{yy}=0$ over the rectangle $0 \leq x \leq S$, $0 \leq y \leq I$. Necessary and sufficient conditions are given for the uniqueness of the solutions. The Dirichlet, and some mixed Dirichlet–Neumann problems are treated for the equation $u_{xx}+k\,u_{xy}-u_{yy}=0$ over a square and a class of rectangles that depend on k. Necessary and sufficient conditions are given for the uniqueness of the solution of the Dirichlet problem and two cases of the mixed Dirichlet–Neumann type. Problems in n-space are also treated. Dissert. Abstr.

N68-37588# College of Aeronautics, Cranfield (England).
AN EXTENDED CLASS OF SUBHARMONIC SOLUTIONS TO DUFFING'S EQUATION
P. A. T. Christopher Oct. 1967 51 p 7 refs
(COA-AERO-199) CFSTI: HC $3.00/MF $0.65

The existence of a new class of exact subharmonic solutions to Duffing's equation was established without damping, i.e., the term in x is absent. The present study is concerned with the full equation of Duffing, with damping present, and it is shown that, provided the damping coefficient, b, is sufficiently small, there exists a class of exact subharmonic solutions which stem from a subclass of exact pure subharmonic solutions. Author

N68-37591 Connecticut Univ., Storrs.
MEASUREMENT OF LINEARLY DEPENDENT PROCESSES
William Howard Jermann (Ph.D. Thesis) 1967 201 p
Available from Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-1360

Given an irreducible and aperiodic finite-state Markov chain, a mapping from the states of this chain to a set of output symbols, a certain finite set of output sequence probabilities, and an upper bound to the possible order of the output process, then it is possible to characterize this random process without reference to the Markov chain generating it. The problem of identifying the parameters characterizing the output process when just statistical estimates of the sequence probabilities are available is considered, and a practical method for identifying binary processes that are functions of Markov chains in which no more than three states of the chain map onto each output symbol is presented. A method for the identification of Markov chains is also presented. Necessary conditions for a function of a Markov chain to be a Markov chain that can be observed by inspection of the nonstochastic matrix characterizing the output process are developed. Methods of synthesizing random processes that are specified by a non-stochastic matrix are developed. Dissert. Abstr.

N68-37606 New Mexico Univ., Albuquerque.
A BEST RUNNING TEST FOR SYMMETRY AND DISTRIBUTION FREE TESTS FOR SYMMETRY
David Lloyd Burdick (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3457

In this dissertation, a running test for symmetry is constructed which stops with arbitrarily small probability if the random variable being observed is symmetric (H_0) and stops with probability one, with the consequent rejection of H_0, if the random variable being observed is not symmetric (H_1). A positive numerical measure of asymmetry is defined for arbitrary random variables which has the property that small values of the measure represent small deviations from symmetry. In terms of this measure, an upper bound for the expected sample size of the constructed running test is obtained. The second section of the dissertation is concerned with a combinatorial question that arises in constructing distribution free tests for symmetry. Dissert. Abstr.

N68-37644# Rocketdyne, Canoga Park, Calif.
RESULTS ON STATISTICAL ESTIMATION AND HYPOTHESIS TESTING WITH APPLICATION TO THE WEIBULL AND EXTREME-VALUE DISTRIBUTIONS
Wright-Patterson AFB, Ohio ARL Apr. 1968 77 p 23 refs
(Contract AF 33(615)-2818)
(ARL-68-0088; AD-672979)

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N68-37645# Rocketdyne, Canoga Park, Calif.
EXACT THREE-ORDER-STATISTIC CONFIDENCE BOUNDS ON RELIABLE LIFE FOR A WEIBULL MODEL WITH PROGRESSIVE CENSORING
In its Results on Statist. Estimation and Hypothesis Testing with Appl. to the Weibull and Extreme Value Distributions Apr. 1968 p 1-16 10 refs (See N68-37644 24-19)

A progressive censoring model arises from a life test of a sample of items in which one or more of the survivors may be removed from the test at the time of any failure. This paper deals with the situation in which the underlying failure-time distribution for the population sampled is the two-parameter Weibull distribution. The reliable life for the population is defined to be the 100(1-R) percent point of the failure-time distribution, where R is a specified population survival proportion, or reliability. An exact confidence bound on reliable life based on three observed ordered failure times is derived for this progressive-censoring model. The criterion used for selecting the order numbers of the three failure times upon which the bound is based depends upon computed values of the power function of the test associated with the bound. A table from which lower bounds can be obtained is given for R equal to .90 and .95, confidence level .90, sample size equal to 2, 3, ..., 6, and all possible censorings. Author

N68-37646# Rocketdyne, Canoga Park, Calif.
A TEST FOR THE HYPOTHESIS THAT TWO EXTREME-VALUE SCALE PARAMETERS ARE EQUAL
In its Results on Statist. Estimation and Hypothesis Testing with Appl. to the Weibull and Extreme Value Distributions Apr. 1968 p 17-32 8 refs (See N68-37644 24-19)

A statistic is determined for testing the hypothesis of equality for scale parameters from two populations, each of which has the first asymptotic distribution of smallest (extreme) values. The probability distribution is derived for this statistic, and critical values are determined and given in tabular form for a one-sided or two-sided alternative, for censored samples of size n_1 and n_2, $n_1 = 2, 3, \ldots, 6$, $n_2 = 2, 3, \ldots, 6$. The power function of the test for certain alternatives is also calculated and listed in each case considered. Author

N68-37647# Rocketdyne, Canoga Park, Calif.
TABLES OF EXPECTED VALUES, VARIANCES AND COVARIANCES OF ORDER STATISTICS FROM THE FIRST ASYMPTOTIC DISTRIBUTION OF SMALLEST (EXTREME) VALUES, FOR SAMPLE SIZES 1 THROUGH 25
In its Results on Statist. Estimation and Hypothesis Testing with Appl. to the Weibull and Extreme Value Distributions Apr. 1968 p 33-60 3 refs (See N68-37644 24-19)

Tables of expected values, variances and covariances are given for order statistics of samples of size n, $n = 1, 2, \ldots, 25$, from the first asymptotic distribution of smallest (extreme) values. The preliminary discussion involves the computation procedures used and accuracy and use of the published values. Author

N68-37648# Rocketdyne, Canoga Park, Calif.
TABLES FOR OBTAINING EXACT LOWER CONFIDENCE BOUNDS ON RELIABLE LIFE UNDER WEIBULL ASSUMPTIONS
In its Results on Statist. Estimation and Hypothesis Testing with Appl. to the Weibull and Extreme Value Distribution Apr. 1968 p 61-64 2 refs (See N68-37644 24-19)

From the m ordered observed logarithms of failure times, $X_1, X_2, \ldots, X_m$, the three observations X_v, X_p, and X_q are chosen, for each combination of m, n, and R, where R specifies a survival proportion of the randomly selected sample of n failure times for a population with a given distribution. Thus, $X_v + C(X_q - X_p)$ has the smallest expected loss and the lower confidence bond t_R at confidence level $1-\alpha$ gives the 100 α percent point of the distribution. Value tables for v, p, q, and V for each combination of n,m, and R, are shown. G.G.

N68-37685 Ohio State Univ., Columbus.
BOOLEAN MATRICES AND FINITE SYSTEMS
Frank Markham Brown (Ph.D. Thesis) 1967 198 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-2958

The theory and applications of "fundamental" Boolean matrices, i.e., matrices whose columns constitute orthonormal subsets of a Boolean algebra is developed. The set of bases for a Boolean matrix is shown to be a lattice, whose least upper bound is the "orthonormal companion" of the set of elements in the matrix. An analogous "fundamental companion" is defined as a fundamental matrix derived from an arbitrary Boolean matrix. The fundamental matrix equations $FX = G$, $XF = G$, and $FX = GX$ are investigated, and the conditions for the existence of fundamental solutions are shown to be succinct and constructive. Finite channels and transducers, the elementary constituents of a finite system without memory, are characterized in terms of fundamental matrices. The introduction of a control channel, in addition to the input and output channels, leads to a generalized transducer whose associated transducer-matrix may have elements from a Boolean algebra larger than the two-element (0,1) algebra. Dissert. Abstr.

N68-37693# System Development Corp., Santa Monica, Calif.
QUASI-HERMITE INTERPOLATION
James Dyer 1 Dec. 1967 20 p
(TM-3734; AD-666374)

A generalization of Hermite interpolation to nonconsecutive derivatives is discussed. Some results are obtained concerning the uniqueness of the generalized interpolating polynomial in the special case of the interpolation of a function and its nth derivative at equally spaced interpolating points. Author (TAB)

N68-37729 Michigan State Univ., East Lansing.
NON-MANIFOLD FACTORS OF EUCLIDEAN SPACES
Alfred John Boals (Ph.D. Thesis) 1967 41 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-4109

This thesis is a study of a class C of decomposition spaces which are shown to be factors of Euclidean space. Assuming that A and B are disjoint compact subsets of E^p, it is known that it is possible to find disjoint compact sets A^* and B^* such that $A \subset \text{int } A^*$ and $B \subset \text{int } B^*$. Sufficient conditions for A and B are given to insure that A^* and B^* can be picked to be cells. The class C of decomposition spaces is defined, and it is proven that the product of any member of C and a line is topologically E^n for some integer n. It is further proven that the product of any two members of the class C is topologically E^{n+m} for suitably chosen integers n and m. Dissert. Abstr.

N68-37733*# Rochester Univ., N. Y. Dept. of Electrical Engineering.
GRAPHICAL APPROXIMATION TO THE DOMAIN OF ATTRACTION FOR SECOND ORDER SYSTEMS
Ryuzo Yokoyama and Edwin Kinnen Aug. 1968 45 p 7 refs
(Grant NsG-574)
(NASA-CR-97311) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A method is described for developing an approximate domain of attraction for a singular point of the ordinary autonomous second order differential equation $\ddot{x} + f(x,\dot{x})\dot{x} + g(x,\dot{x}) = 0$, where f and g are finite order polynomials in x and $\dot{x}$. Reverse solution trajectories are calculated for domain boundaries from a selective set of end point conditions known to belong to the domain of attraction. The latter is found initially from an arbitrarily chosen Liapunov function. The process is arranged for machine computation and is particularly effective for equations with solution trajectories not exhibiting limit cycles. Author

N68-37736# Stanford Univ., Calif. Dept. of Statistics.
MULTIPLE TIME SERIES MODELLING
Emanuel Parzen 8 Jul. 1968 43 p
(Contract NONR-225(80))
(TR-12; AD-672023)

The paper seeks to provide a general framework for the theory and practice of multivariate analysis of time series. It seeks to compare: (1) Spectral approaches to finding relations among time series. (2) Time domain or innovations approaches to finding relations among time series. The paper also seeks to focus attention on: (3) Innovations approaches to cross-spectral estimation. (4) The problem of multivariate analysis of the joint innovations covariance matrix and the sampling properties of its estimators. The various sections are entitled: (2) Innovation Approaches to Modelling; (3) Spectral Approaches to Modelling; (4) Relations Between Time Series; (5) Autoregressive Approach to a Single Series; (6) Multiple Spectral Density Estimation. Author (TAB)

N68-37949# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
FURTHER RELATIONS BETWEEN GAME THEORY AND EIGENSYSTEMS
Gerald L. Thompson and Roman L. Weil, Jr. Jul. 1968 13 p refs *Its* Management Sci. Res. Rept. No. 136
(Contract Nonr-760(24); Grant NSF GS-1541)
(AD-673663)

Some new results that relate matrix game theory to the eigenvectors and eigenvalues of square, real or complex, matrices are presented. Specifically, game-theoretics characterization are given for eigenvectors all of whole ccomponents are non-negative. Other results are also presented. Author (TAB)

N68-37968# Minnesota Univ. Minneapolis. School of Mathematics.
THE ANALYTICITY OF SOLUTIONS OF SINGULAR INTEGRAL EQUATIONS
Charles S. Kahane Jul. 1968 68 p refs
(Contract Nonr-4689(00))
(AD-673550)

The author studies the analyticity properties of solutions of the equation $g = Kf$ where K is a singular integral operator of the Calderon-Zygmund type with g and f in L_p. Assuming that g and K are locally analytic in a suitable sense and that the symbol of the operator K is locally not equal to 0, any solution of the equation $g = Kf$ is shown to be locally analytic. This generalizes the well-known result that solutions of linear analytic elliptic partial differential equations are themselves analytic. Author (TAB)

N68-37978# Lincoln Lab., Mass. Inst. of Tech., Lexington.
NUMERICAL INTEGRATION OF DIFFERENTIAL EQUATIONS BY THREE METHODS—EQUATIONS FOR, DESCRIPTIONS OF COMPUTER ROUTINES, DISCUSSION OF RESULTS
William B. Smith 21 Aug. 1968 18 p refs
(Contract AF 19(628)-5167)
(ESD-TR-68-248; TN-1968-31; AD-674598)

Three very different methods (from the literature) for the integration of differential equations by numerical methods are described. Formulas are given for two methods, and a computer program realization of the third is described. Author (TAB)

N68-37982 Technische Hochschule Hannover (West Germany).
RESEARCH ON NON-STANDARD MODELS [UNTERSUCHUNGEN UEBER NICHTSTANDARD-MODELLE]
Klaus Potthoff (Ph.D. Thesis) 1967 82 p In GERMAN

Developed is a simple theory of types for approximation calculus where it is shown that the ultra production construction is valid for the interpretation of that calculus and where the finite rule applies. Properties of non-standard models are defined by convergent relationships and used to form the topological structures of non-standard models for approximate spaces. Transl. by G.G.

N68-38129# Texas A&M Univ., College Station. Inst. of Statistics.
STRATIFIED MONTE CARLO SAMPLING FOR SYMMETRIC STATISTICS
L. J. Ringer and S. Suharto Aug. 1968 17 p refs
(Grant DA-ARO-31-124-G793)
(TR-9; AD-674237) CFSTI: HC $3.00/MF $0.65

The use of stratified sampling procedure for Monte Carlo estimation of the c.d.f. of a statistic is discussed. It is shown that this sampling procedure will give estimates with smaller variance than those obtained from simple random samples. The reduction in variance is illustrated by considering the estimation of the distribution of the sample mean and sample range for a sample from a rectangular distribution. Author (TAB)

N68-38130# California Univ., Los Angeles. Dept. of Mathematics.
FINITE-DIMENSIONAL TERNARY ALGEBRAS
Howard Barry Ritea (Ph.D. Thesis) 1967 153 p refs
(Contract DA-31-124-ARO(D)-355; Grant Nonr-233(76))
(Rept.-67-5; AD-674312) CFSTI: HC $3.00/MF $0.65

A ternary algebra is a linear space Alpha over the complex numbers such that for any three elements A, B and C in Alpha there exists a product AB*C in Alpha satisfying certain axioms which reduce to ordinary properties of matrix multiplication when the elements of Alpha are matrices and * denotes conjugate transpose. The present paper is devoted to a study of the algebraic structure of ternary algebras. In particular it is shown that an arbitrary finite-dimensional ternary algebra has a representation as a ternary algebra of matrices. Author (TAB)

N68-38143# Army Test and Evaluation Command, White Sands Missile Range, N. Mex.
A VECTOR SPACE DERIVATION—USING DYADS—OF WEIGHTED LEAST SQUARES FOR CORRELATED NOISE
James S. Pappas Jun. 1968 76 p refs
(RO-S-68-1; AD-674190) CFSTI: HC $3.00/MF $0.65

Matrix-analysis and recursive matrix computing subroutines offer hope of relieving the current computer data deluge. Classical weighted least squares for multivariable parameter estimation in the presence of correlated noise are developed in a geometrical vector space setting. Rank-one matrices, or dyads, are used extensively, especially in obtaining gradients of traces of variance matrices. Author (TAB)

N68-38153# Wisconsin Univ., Madison. Mathematics Research Center.
SPECTRAL GENERALIZED INVERSES OF SQUARE MATRICES
T. N. E. Greville Oct. 1967 80 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-823; AD-674455) CFSTI: HC $3.00/MF $0.65

For a given singular square matrix A, this report studies the existence and properties of matrices X satisfying AXA = A and XAX = X, and having, insofar as possible, the spectral properties of the ordinary inverse. Author (TAB)

N68-38214# System Development Corp., Santa Monica, Calif.
A NEW METHOD OF ESTIMATING THE WEIBULL SHAPE PARAMETER
V. K. Murthy Wright-Patterson AFB, Ohio ARL Apr. 1968 28 p refs
(Contract F33615-67-C-1865)
(ARL-68-0076; TM-80038; AD-674063) CFSTI: HC $3.00/MF $0.65

The method of random hazard functions is applied to the case of the Weibull distribution and the following results are obtained: It is well known that, in the case of a Weibull distribution with two parameters alpha and beta, there is no way of estimating and testing for the shape parameter beta without knowledge of the scale parameter alpha using the usual methods based on maximum likelihood. The method of random hazard functions is now used to obtain a consistent and asymptotically normal class of estimates for beta independent of any specification whatsoever on alpha. This result enables one to test for the randomness of the underlying failure phenomena under the Weibull set up. An illustrative example is given. Author (TAB)

N68-38222# Wisconsin Univ., Madison. Mathematics Research Center.
DATA FITTING BY SPLINE FUNCTIONS
T. N. E. Greville Jun. 1968 35 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-893; AD-674460) CFSTI: HC $3.00/MF $0.65

The basic theory of interpolation of data points by spline functions and their role in approximation of linear functionals is presented from an elementary point of view. Author (TAB)

N68-38235# Stanford Univ., Calif. Dept. of Statistics.
ON THE INVERSE OF THE COVARIANCE MATRIX OF A FIRST-ORDER MOVING AVERAGE
Paul Shaman 5 Aug. 1968 27 p refs
(Contract DA-ARO(D)-31-124-G726)
(SU-TR-25; AD-674765) CFSTI: HC $3.00/MF $0.65

Let (x sub t) be a first-order moving-average process; that is, x sub t = epsilon sub t + beta (epsilon sub t-1), where the sequence (epsilon sub t, t = 0, plus or minus 1,...) consists of uncorrelated random variables with mean 0 and variance v, and the absolute value of beta is < 1. Another parameterization which is useful involves sigma squared = v(1 + beta squared) and sigma squared rho = v(beta). This paper discusses the problem of inverting the covariance matrix Sigma sub T of x = (x sub 1,..., x sub T). Author (TAB)

N68-38236# RAND Corp., Santa Monica, Calif.
AN INITIAL-VALUE METHOD FOR THE SIMPLEST PROBLEM IN THE CALCULUS OF VARIATIONS
R. Kalaba and R. Sridhar Sep. 1968 15 p refs
(Contract F44620-67-C-0045)
(RM-5737-PR; AD-674584)

The report describes a method for converting certain optimization problems in the calculus of variations into initial-value problems that can be solved effectively by analog or digital computers. No direct use of Euler equations or dynamic programming is involved. This provides a new conceptual framework for variational problems that has both computational and analytical advantages. Author (TAB)

N68-38242# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
THE DISCRETE MAXIMUM PRINCIPLE WITH APPLICATIONS TO MANAGEMENT SCIENCE
G. B. Kleindorfer, P. R. Kleindorfer, and G. L. Thompson Jul. 1968 29 p refs
(Contract Nonr-760(24))
(RR-137; AD-674392) CFSTI: HC $3.00/MF $0.65

A general version of the discrete control system is formulated which includes difference inequalities and the possibility of inequality as well as equality state space constraints. The authors apply the well-known Kuhn-Tucker theorem to derive necessary conditions that the primal and adjoint functions must satisfy in order that they be a solution to the optimum control problem. These necessary conditions are valid only if the constraint qualification holds. One of the necessary conditions is the Pontryagin maximum principle. A special version of the general problem is stated, and applied to a separable non-linear programming problem. Finally, production control examples are solved by means of the theory. Author (TAB)

N68-38269# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Research Labs.
AN ALTERNATE DERIVATION OF SOME EQUATIONS OCCURRING IN A PAPER BY KRAICHNAN
Karl G. Guderley Apr. 1968 113 p ref
(ARL-68-0075; AD-674595) CFSTI: HC $3.00/MF $0.65

Paper gives a detailed derivation of some of the formulae that appear in the paper of Robert H. Kraichnan, Dynamics of Nonlinear Stochastic Systems, (Journal of Mathematical Physics, February 1961). The irreducible diagrams that play an important role in this paper arise in a natural way by a special method of matrix inversion. On this basis most of the important formulae of Kraichnan can be obtained in a rather lucid way. An appendix contains a detailed study of the relation between averages of the original system and in collective coordinates. Author (TAB)

N68-38274# Texas A&M Univ., College Station. Statistics Inst.
GOODNESS OF FIT WITH UNKNOWN PARAMETERS
F. M. Speed and W. B. Smith Aug. 1968 15 p refs
(Grant DA-ARO(D)-31-124-G793)
(AROD-4721.13-M; TR-10; AD-674238) CFSTI: HC $3.00/MF $0.65

The paper proposes to calculate new tables for several of the measures given by Riedwyl when the null distribution is normal and when the parameters are estimated from the data. In addition comparisons of the power under these conditions are made between the K-S statistic and those proposed by Riedwyl. Author (TAB)

N68-38275# Texas A&M Univ., College Station. Statistics Inst.
SIMULATION STUDIES OF THE KOLMOGOROV–SMIRNOV TEST ON DISTRIBUTIONS WITH UNKNOWN PARAMETERS
W. B. Smith and F. M. Speed Aug. 1968 11 p refs
(Grant DA-ARO(D)-31-124-G793)
(AROD-4721.11-M; TR-8; AD-674236) CFSTI: HC $3.00/MF $0.65

The standard Kolmogorov-Smirnov (K-S) test is valid when the null distribution is completely specified. Lilliefors (1967) shows for the case when the null distribution is normal, but the mean and variance are unknown and must be estimated from the data, that the K-S test is extremely conservative. This research constructs by Monte Carlo simulation tables of critical values for the K-S statistic when the null distribution is either negative exponential or rectangular with unknown parameters that are to be estimated from the data. The results indicate also that the standard K-S test is conservative. Moreover, power studies are simulated in both cases. These studies indicate the danger of using the K-S test for small samples. Author (TAB)

N68-38277# Texas A&M Univ., College Station. Statistics Inst.
APPROXIMATE GENERATION OF RANDOM VARIABLES
S. Suharto Aug. 1968 13 p refs
(Grant DA-ARO(D)-31-124-G793)
(AROD-4721.15-M; TR-12; AD-674240) CFSTI: HC $3.00/MF $0.65

In many situations when a Monte Carlo procedure is used to solve some statistical problems, the computational work can be very excessive, since the number of samples, *N*, must usually be very large in order to obtain an adequate degree of accuracy. Let x sub 1, x sub 2,...,x sub n be a random sample drawn from the parental distribution f(x) with cumulative distribution F(x) and let h(x sub i) be a statistic which is a function of the observations x sub i. Then, the Monte Carlo procedure for evaluating P(h = or < H) may be described as follows: (a) generate random uniform variates, u sub i; (b) transform the uniform variate u sub i into x sub i with the help of x sub i = (F superscript -1)(u sub i); (c) evaluate the statistic h(x sub i) and determine the proportion for which h(x sub k) = or < H. The present paper is concerned with part (b) only. TAB

N68-38336# Texas A&M Univ., College Station. Statistics Inst.
LINEAR MODELS WITH UNIFORMLY DISTRIBUTED RESIDUALS
A. P. Rainosek Aug. 1968 20 p refs
(Grant DA-ARO-31-124-G793)
(AROD-4721.14-M; TR-11; AD-674239) CFSTI: HC $3.00/MF $0.65

In this paper we consider regression analysis assuming uniformly distributed residuals for the general-linear-hypothesis model of full rank Y = X beta + e where Y is a n x 1 observable random vector, X is a n x k matrix of known values with rank = k where k = or < n, beta is a k x 1 vector of unknown parameters, and e is a n x 1 unobservable random vector. Author (TAB)

N68-38341# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
UNIFIED TREATMENT OF VECTORS AND TENSORS IN N-DIMENSIONAL EUCLIDEAN SPACE
Shunsuke Takagi Jun. 1968 52 p refs
(CRREL-RR-207; AD-674186) CFSTI: HC $3.00/MF $0.65

A unified treatment of vectors, tensors and multivectors in n-dimensional Euclidean space is presented. The unified treatment is so systematized that n-dimensional tensors of arbitrary order are treated similarly to three-dimensional vectors. Work on this subject was done in connection with difficulties which arise in the continuum mechanics pertaining to large deformations of such media as soil and snow. Author (TAB)

N68-38361# Naval Postgraduate School, Monterey, Calif.
ON SOLVING INTEGER PROGRAMS
Harold Greenberg May 1968 50 p refs
(NPS55GD-8051A; AD-673951)

The report contains new methods of finding integer solutions to linear programming problems. The approaches presented, with illustrative examples, emphasize the use of dynamic programming techniques. In addition, a new branching scheme is presented that is a natural extension of linear programming methods. Author (TAB)

N68-38434# Northwestern Univ., Evanston, Ill. Dept. of Industrial Engineering and Management Sciences.
PROOF PROCEDURES AND DECISION PROCEDURES BASED ON THE RESOLUTION METHOD
Bruce Kallick (Ph.D. Thesis) Aug. 1968 120 p refs
(Grant AF-AFOSR-1125-66)
(AFOSR-68-1823; AD-674004)

A decision procedure for satisfiability of predicate calculus formulas in the E sub m A sub 2 E sub n prefix class is described. The procedure is a hybrid based on Joyce Friedmans decision procedure and on J. A. Robinsons resolution method. It most resembles the latter parent, in that resolvent-clauses are formed from the clauses of a formula expressed in conjunctive normal form and from other resolvent-clauses until two complementary one-literal clauses resolve into the empty clause. Unlike the general resolution method, however, the procedure does not generate literals with nested Skolem-functions; there is therefore a bound on literal-length and the procedure terminates even if the empty clause is not generated. Several examples are given and the procedure is compared with the two parent procedures. It is suggested that there may be some implications for theorem-proving procedures based on the resolution method in the direction of curtailing literal-length at the expense of increasing the required number of resolvents if in so doing the over-all computational effort can be reduced, e.g., by avoiding character manipulation. It is shown that the procedure may be readily modified to decide the two matrix-defined classes of Skolem normal form formulas whose solvability was established by Friedmans method. The procedure has been programmed (in Algol) for the restricted class of formulas having only dyadic predicates and some refutations produced by the program are included in an appendix. Author (TAB)

N68-38441# Purdue Univ., Lafayette, Ind. Statistics Dept.
DECISION THEORETIC APPROACH TO SOME MULTIVARIATE PROBLEMS
Herman Rubin Aug. 1968 15 p refs *Its* Mimeograph Ser. 167
(Contract N00014-67-A-0226)
(AD-674524) CFSTI: HC $3.00/MF $0.65

Some problems of multivariate analysis are considered from a decision-theoretic standpoint. Reasons are given for this to be done in practical situations, and some suggestions are made which, it is hoped, will lead to useful practical procedures. Author (TAB)

N68-38448# Stanford Univ., Calif. Dept. of Operations Research.
DISCRETE DYNAMIC PROGRAMMING WITH SENSITIVE DISCOUNT OPTIMALITY CRITERIA
Arthur F. Veinott, Jr. 30 Aug. 1968 62 p refs
(Contract Nonr-225(77); Grant NSF GK-1420)
(TR-16; AD-673965)

Stationary, discrete and continuous time parameter, finite state and action Markovian decision processes with substochastic transition matrices are studied where the future rewards are discounted. The methods of successive approximations and policy improvement are shown to converge to the maximal expected discounted reward when the interest rate is negative provided the expected discounted time until the process stops is finite under every stationary policy. A family of discount optimality criteria of varying degrees of sensitivity is introduced. The family includes and unifies the discount criteria studied by Blackwell. The existence of stationary optimal policies is established constructively and the class of such policies is characterized. The algorithms are essentially specializations and refinements of a policy improvement method recently devised by Miller and the author for finding stationary policies having maximal expected discounted reward for all small enough positive interest rates. The results exploit the fact that the Laurent expansion in rho (the interest rate) about the origin of the discounted return under a stationary policy has a simple form.
Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-37587# Argonne National Lab., Ill.
FIFTEEN-YEAR CLIMATOLOGICAL SUMMARY, 1 JANUARY 1950-31 DECEMBER 1964
Harry Moses and Mary A. Bogner Sep. 1967 671 p 17 refs
(Contract W-31-109-ENG-38)
(ANL-7084)

Meteorological data pertinent to the problems of the atomic energy industry have been collected at the Argonne National Laboratory meteorology observation site since Jul. 1, 1949. The data reported cover the period from January 1, 1950, through December 31, 1964. The data are presented in three parts.
NSA

N68-37689 Missouri Univ., Columbia.
DYNAMIC PRESSURE EFFECTS IN ORGANIZED CONVECTION
Ronnie Lee Alberty (Ph.D. Thesis) 1967 85 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-3592

A summary of observational evidence is presented which supports the hypothesis that well organized convective elements in the atmosphere act as obstacles to the environmental flow. On the basis of this hypothesis, it is shown that dynamic pressures exist within the storm near the strong updraft cores characteristic of such convection. Vertical shear in the environmental flow is shown to yield vertical gradients of dynamic pressure within the storm which can produce appreciable contributions to vertical motions. Utilizing the above conclusions, a simple but plausible model of a quasi-steady state cumulonimbus is proposed. Based on the model, numerous quantitative case studies are made. The results of four such studies are presented in graphical form and are discussed in detail. Implications applicable to many commonly observed phenomena related to convective activity, which follow from the results of the model, are discussed including a proposed causal relationship of the life cycle of severe and persistent convective storms.
Dissert. Abstr.

N68-37684 California Univ., Los Angeles.
THE EFFECT OF CIRRUS CLOUDS ON INFRARED SKY RADIANCE
Freeman Franklin Hall, Jr. (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-3260

An experimental investigation of infrared sky radiance and radiance fluctuations in the 8 to 13 micron atmospheric window is reported. Measurements were made with ground-based, filtered bolometer detector radiometers under clear sky and cirrus overcast conditions. Sky radiance was measured very close to the limb of the sun to permit detection of the solar aureole caused by forward scattering by cirrus ice crystals. Polarized sky radiance was found at large zenith angles and is attributed to scattering by cirrus of thermal emission from the earth. The radiance due to tropospheric water vapor is predicted by means of a radiation chart. Diffraction about cirrus cloud particles leads to a prediction of a solar aureole of size which corresponds to the measured aureole.
Dissert. Abstr.

N68-37746# American Meteorological Society, Boston, Mass.
THE THICKNESS AND RADIATION CHARACTERISTICS OF ST AND SC CLOUDS AS DETERMINED BY THE INTENSITY OF TOTAL RADIATION AT THE SURFACE OF THE EARTH [OPREDELENIE MOSHCHNOSTI I NEKOTORYKH RADIATSIONNYKH KHARATERISTIK SLOISTYKH I SLOISTO-KUCHEVYKH OBLAKOV PO INTENSIVNOSTI SUMMARNOI RADIATSII U POVERKHNOSTI ZEMLI]
N. I. Goisa et al Bedford, Mass. AF Cambridge Res. Labs. Jan. 1968 32 p 15 refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorologicheskii Inst. (Kiev), no. 48, 1968 p 79-95
(Contract AF 19(628)-3880)
(TR-562; AD-667413)

The relation between the intensity of total radiation at the surface of the earth and the thickness of ST and SC clouds is investigated. Nomograms are plotted which permit the thickness of ST and SC layers to be determined with adequate accuracy. The nomograms are used to compute the coefficients of the total extinction of radiation by clouds and to derive the relationship of these coefficients with the altitude of the sun and the thickness of the cloud layer.
Author (TAB)

N68-37844# Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 88, NO. 2: SYNOPTIC STATISTICAL ANALYSIS OF STORM WEATHER SITUATIONS OVER CENTRAL AND EASTERN EUROPE [METRORLOGISCHE ABHANDLUNGEN. BAND LXXXVI, HEFT 2: SYNOPTISCH-STATISTISCHE UNTERSUCHUNGEN ZU STURMWETTERLAGEN IN MITTEL-UND OSTEUROPA]
Jurgen Sussebach 1968 117 p In GERMAN; ENGLISH summary
CFSTI: HC $3.00

A synoptic-statistical analysis of 291 storm weather situations over Central and Eastern Europe of the period 1950-1961 was carried out in order to develop forecast rules. Several types and subtypes of different storm developments were distinguished, because of their great variety, a methodical classification into geographical cyclone tracks was required. Storm depressions approaching from west-southwesterly to northwesterly directions represent the most frequent types; they are characterized by the largest and most intensive storm areas. Vb-depressions and storm cyclones moving on more easterly tracks from the Black Sea northward only seldom

are accompanied by storm areas of similar castastrophic extent. A special method made possible the construction of mean surface and upper level charts as well as mean deviation charts from the normal pressure pattern. They are useful to the forecaster. Furthermore the mean charts were the basis for statistical treatment. This resulted in fixed parameters representing quantitative forecast rules. Three individual storm situations are described by means of weather charts, satellite photos, cross-sections, wind and pressure recordings. Author

N68-37867# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
THE DIURNAL TIDE NEAR THE STRATOPAUSE OVER WHITE SANDS MISSILE RANGE, NEW MEXICO
Norman J. Beyers, Bruce T. Miers, and Elton P. Avara Feb. 1968 35 p 6 refs
(AD-667909)

The results of the analysis of over three hundred meteorological rocket soundings of the stratosphere and lower mesosphere are summarized. Two basic parts of the summary are the atmospheric tidal experiments and the delineation of the diurnal tide in summer data obtained over White Sands Missile Range. Phase and amplitude determinations of the diurnal variation of the zonal and meridional components were significant and predictable. These values then could be used to improve wind forecasts and existing statistical summaries of the Meteorological Rocket Network in the summer stratopause region over White Sands Missile Range, New Mexico. Author (TAB)

N68-37869*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SATELLITE VIEW OF TYPHOON MARIE 1966 DEVELOPMENT
G. Warnecke, L. J. Allison, E. R. Kreins (Environ. Tech. Appl. Center) and L. M. McMillin (Allied Res. Assoc., Inc., Concord, Mass.) Nov. 1967 98 p 13 refs
(NASA-TN-D-4757) CFSTI: HC $3.00/MF $0.65 CSCL 04B

A complete documentation of Nimbus II High Resolution Infrared Radiometer data and ESSA-3 photographs is presented for the life-time of Typhoon Marie 1966. Particular emphasis was given to the earliest stages of noticeable storm development. The interpretation of the satellite data in combination with the sparse conventional observations from the central Pacific Ocean revealed meteorological conditions in the development area which are commonly found necessary for tropical storm development. Author

N68-37891 Washington Univ., Seattle.
A LINEAR MODEL OF LARGE-SCALE TROPICAL DISTURBANCES
David Roy Rodenhuis (Ph.D. Thesis) 1967 140 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-3876

A scale analysis is made of the governing equations for large-scale intertropical flow, assuming gravitational stability and hydrostatic balance. The results indicate the importance of nonlinear advective terms, the linear effects of the earth's rotation, and diabatic processes. In order to study the effects of diabatic heating on the large-scale flow, a linear, inviscid and hydrostatic model is proposed. The vertical component of the earth's rotation is constant and diabatic effects are made proportional to both the vertical velocity and the space coordinates. The effect of this parameterization is to define an equivalent static stability which is spatially variable, and is negative in a small region near the origin. Dissert. Abstr.

N68-37920# Air Weather Service, Scott AFB, Ill.
INTERRELATION OF IONOSPHERIC SPORADIC E WITH THUNDERSTORMS AND JET STREAMS
Thomas D. Damon May 1968 27 p refs
(AWS-TR-204; AD-672028)

Reports of the occurrence of ionospheric sporadic E clouds from radio amateurs operating on a frequency near fifty megahertz are analyzed on a synoptic scale and compared with the occurrences of thunderstorms and of jet streams. A mechanism is suggested for the observed interrelation between Es and thunderstorms. No definite conclusion is drawn concerning the possible relationship between Es and jet streams. Author (TAB)

N68-37926# Naval Postgraduate School, Monterey, Calif.
NUMERICAL METHODS OF COMPUTING THREE-DIMENSIONAL TRAJECTORIES FOR ADIABATIC FLOWS Scientific Report
J. D. Mahlman Aug. 1968 37 p refs
(NPS-51MZ8061A; AFCRL-68-0357; SR-3; AD-674602) CFSTI: HC $3.00/MF $0.65

A computer method for objective computation of adiabatic three-dimensional trajectories in the free atmosphere is presented. This technique utilizes a digital adaption of the graphical iterative method introduced by Danielsen (1961). The program is applied to a test case and is found to give generally satisfactory results. Some difficulties are encountered in cases of very low wind speeds and also in regions of strong anticyclonic wind shears. A method for inclusion of diabatic effects is outlined in detail. This approach may allow investigation of more complicated flow problems than have been previously possible. Author (TAB)

N68-37946*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LOW LEVEL WIND GUST AMPLITUDE AND DURATION STUDY
Dennis W. Camp 21 Aug. 1968 37 p refs
(NASA-TM-X-53771) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Information is presented on low level wind gust amplitude and gust frequency of occurrence as a function of gust duration period. The wind data from which these characteristics were determined were obtained from NASA's 150-meter Meteorological Tower Facility located in the Merritt Island Launch Area at the Kennedy Space Center, Florida. It is shown that a statistical gust shape may be characterized by a fast build-up rate, a constant mid-portion, and a fast decay rate, and that the largest percentage of gusts occurs for the shortest gust duration period. Author

N68-38037# Joint Publications Research Service, Washington, D. C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys. Astronomy, and Space, No. 189 1 Oct. 1968 p 17-51 refs (See N68-38035 24-13)

News and abstracts of scientific articles on meteorology are presented from the Soviet-bloc literature. Books on telemetry, convective clouds, and radar meteorology are reviewed; studies on water consumption and water levels, winter cloud modification, and digital filters for data processing are reported; and a conference on meteorology and physics of the atmosphere is mentioned. Scientific abstracts deal with turbulence in boundary layers and effect of temperature stratification, ball lightning formation, and water-bearing fissure zones below the permafrost. Characteristics of night-time storms, jet stream turbulence, and statistical characteristics of wind variability are described. Other abstracts cover vertical heat exchange, wind disturbances, and aerosol particles in the atmosphere; mean temperature in the shear layer and atmospheric convection with vertical shear; and nonlinear effects in cellular convection when nonlinear advective terms are included. M.W.R.

N68-38041 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 90, NO. 2: RESULTS OF THE ASCENTS OF THE RADIOSONDE STATION, BERLIN-TEMPLEHOF, OF THE INSTITUT FUER

METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAET BERLIN, FEBRUARY 1968 [METEOROLOGISCHE ABHANDLUNGEN. BAND 90, HEFT 2: ERGEBNISSE DER AUFSTIEGE DER INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1968, FEBRUAR]

Richard Scherhag 1968 82 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

Detailed data obtained by radiosonde ascents during February 1968 are presented. Monthly time cross sections of the averaged temperature and the zonal and meridional wind components at heights above 30 km were constructed from these data. Extreme and mean values of temperature, pressure, geopotential, wind data, refractivity, pseudopotential temperature, and velocity of sound were extracted for all standard pressure surfaces, several height levels, the tropopause, and the freezing level. The data of the ozone ascents are given in tabulated and graphical forms. Author

N68-38042 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 90, NO. 3: RESULTS OF THE ASCENTS OF THE RADIOSONDE STATION, BERLIN-TEMPLEHOF, OF THE INSTITUT FUER METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAET BERLIN, MARCH 1968 [METEOROLOGISCHE ABHANDLUNGEN. BAND 90, HEFT 3: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION, BERLIN-TEMPLEHOF, DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1968, MAERZ]

Richard Scherhag et al 1968 93 p refs
CFSTI: $3.00

Detailed data obtained by radiosonde ascents during March 1968 are presented. For abstract of contents, see N68-38041.

N68-38043 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 90, NO. 4: RESULTS OF THE ASCENTS OF THE RADIOSONDE STATION, BERLIN-TEMPLEHOF, OF THE INSTITUT FUER METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAET BERLIN, APRIL 1968 [METEOROLOGISCHE ABHANDLUNGEN. BAND 90, HEFT 4: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION, BERLIN-TEMPLEHOF, DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1968, APRIL]

Richard Scherhag et al 1968 92 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

Detailed data obtained by radiosonde ascents during April 1968 are presented. For abstract of contents, see N68-38041.

N68-38045# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

WIND CORRELATION AND VARIABILITY IN TIME AND SPACE

Manuel Armendariz and Virgil D. Lang Jul. 1968 43 p refs
(ECOM-5201; AD-674179)

Wind velocity data gathered from three Aerovane anemometers arranged in a triangular array were compared for varying lag times and sample averaging intervals. The anemometers were placed 275 meters apart at the vertices of an equilateral triangle at a height of 19 meters above the surface. Correlation coefficients, coherence, and root mean square (RMS) of wind velocity differences between anemometers were computed for different stability regimes and varied lag times. The wind direction relative to lines drawn between the instruments was considered in the analysis. In general, it was found that as stability increases, the correlation and coherence functions become smaller. There is a rapid drop in correlation as the lag time is increased, with negligible correlation after 100 seconds elapsed time. The advantage of using a long sampling interval in predicting the wind in time and space is demonstrated. Author (TAB)

N68-38047# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.

ADAPTATION BETWEEN THE PRESSURE AND THE WIND FIELD IN MESO-SCALE AND SMALL-SCALE MOTIONS

Yeh Tu-cheng et al Bedford, Mass. AFCRL May 1968 29 p refs Transl. from Ch'i Hsiang Hsueh Pao (Peking), v. 34, no. 4, Nov. 1964 p 409-423
(Contract AF 19(628)-5073)
(AFCRL-68-0275; AD-674760)

It is pointed out that in addition to the so-called geostrophic adaptation in a large-scale motion, there is an adaptation between the pressure and the wind field in meso- and small-scale motions. Scale analysis shows that in the equations of motion (meso- or small-scale), the term for the time derivative is an order of magnitude smaller than the main terms. Hence, we may assume that motions of such scales evolve slowly in a quasi-balanced state. If, for any reason, this state of motion is disturbed, there will be a mechanism to restore it. A quasi-balanced state exists between the inertial force (velocity advection), the coriolis force and the pressure gradient force. The progression from disturbance to restoration of a quasi-balanced state is known as an adaptive process and the evolution in a quasi-balanced state a quasi-steady process. The physical nature of these two processes is discussed. It is shown that for a meso-scale motion, $D >> \zeta$ in an adaptive process and $D = \sigma r < \zeta$ in a quasi-steady process, D and zeta being the divergence and vorticity, respectively. If in some limited region the balanced state of the motion is violently disturbed, further development of this motion may be calculated as an initial-value problem. Calculated results show that within the initial short time interval, the meteorological elements undergo a rigorous change in which the quasi-balanced state is re-established and the motion enters a quasi-steady state. Author (TAB)

N68-38118 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 88, NO. 1: CHANGES OF CIRCULATION IN THE STRATOSPHERE OVER A PERIOD OF SEVERAL YEARS [METEOROLOGISCHE ABHANDLUNGEN. BAND <XXXVI, HEFT 1: MEHRJAEHRIGE ZIRKULATIONSSEHWANKUNGEN IN DER STRATOSPHAERE]

Ulrich Ruege 1968 261 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

The monthly mean stratosphere charts of this institute for the period 1957-66 and those of Muench (1962) for the years 1955-59 are combined in new 50-mb maps of the 11-year-period 1955-66; they represent a solar cycle including maximum 1957/Oct. and minimum 1964/June. The yearly mean flow in the 50-mb surface is described, and details are given of the circulation in 1960 and 1961. Circulation changes were determined by studying mean latitudinal values and radiosonde data. Records show a distinct quasi-biennial oscillation in a parallelism to the solar cycle variation of the geomagnetic index. These solar cycle variations are also contained in higher latitude means (90° - 60°), while the lower latitudes are only submitted in a quasi-biennial period. This results in a deepening of the polar vortex and a strengthening of the meridional pressure gradient in case of decreasing solar activity. The thickness 50/1000 mb, area-weighted over the latitudinal means, yields a temperature range of 0.5°C, including a weak cooling since 1958-59. In the 50-mb temperatures a decrease of 0.3°C from 1964-65 (IQSY) to 1957-58 (IGY) is shown. The

stratospheric mean charts are classified in two main types and two derived types. Extreme situations are not necessarily connected with asymmetry of the centers of circulation; weak and strong polar vortices could be in similar positions in different years. K.W.

N68-38134# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
CONVECTIVE INSTABILITY OF INERTIA WAVES AND PHYSICAL ANALYSIS OF THE FORMATION OF TYPHOONS AT THE EARLY STAGE
Chu-Shih Chen Bedford, Mass. AFCRL May 1968 25 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 34, no. 4, 1964 p 433-442
(Contracts F19628-68-C-0251; AF 19(628)-5073)
(EMM-66-132; AFCRL-68-0292; AFCRL-TRANS-8; AD-674976)

The paper discusses mainly the adjustment of the thermal wind in a moist atmosphere at low latitudes when the condition of convective instability is satisfied. Initially, if the thermal vorticity of the wind field is larger than that of the temperature field and the horizontal scale of the disturbance is smaller than the characteristic scale of the adjustment, convective instability of the inertia waves will occur. The paper also discusses the dynamical essence of the triggering mechanism for typhoon formation. Author (TAB)

N68-38138# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
A NUMERICAL STUDY OF THE GENERAL CIRCULATION OF THE ATMOSPHERE
Chen Yung-San Bedford, Mass. AFCRL May 1968 39 p refs *Its* Trans-7
(Contract F19628-68-C-0251; AF 19(628)-5073)
(AFCRL-68-0291; EMM-66-133; AD-674475)

A two-level quasi-geostrophic model which includes the distribution of land and sea in the northern hemisphere with the effects of topography and heating taken into account is set up for a numerical study of the general circulation of the atmosphere. The influences of clouds on long and short-wave radiation in radiational heating are considered, with the assumption that the appearance of clouds depends only on the vertical current. The surface temperature is obtained by solving the heat conduction equation. The nonlinear ordinary differential equations derived are integrated numerically on an electronic computer using the Runge-Kutta method. The cool air over Asia and the Pacific and the warm air over Europe and the Atlantic in winter can be attributed to the thermal properties of the distribution of land and sea in the northern hemisphere. Topography and non-adiabatic heating are jointly responsible for the formation of troughs over East Asia and North America as well as for the cold-air activity which usually originates in Novaya Zemlya in Soviet Russia and migrates southeastward. Author (TAB)

N68-38147# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 88, NO. 4: STUDIES OF THE SYNOPTIC-GEOGRAPHIC DISTRIBUTION OF TROPOSPHERIC COLD AND WARM AIR FRONTS AND RELATED GROUND-LEVEL PRESSURE CHANGES IN THE NORTHERN HEMISPHERE [METEOROLOGISCHE ABHANDLUNGEN, BAND 86, HEFT 4: UNTERSUCHUNGEN UEBER DIE SYNOPTISCHGEOGRAPHISCHE VERTEILUNG VON TROPOSPHAERISCHEN KALT- UND WARMLUFTEINBRUECHEN SOWIE DER DAMIT VERBUNDENEN BODENDRUCKAENDERUNGEN AUF DER NORDHALBKUGEL]
Horst Malberg 1968 147 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

The first part of the present paper shows how many days of tropospheric cooling and heating can be expected each month in the different regions of the Northern Hemisphere. In a first approximation, the following almost congruent distribution results: The frequency of cooling and heating increases from the polar region toward the middle latitudes, reaches its maximum in the latitudes 55 to 45, and decreases toward the south. The area of high frequency can be divided into a northern American-Atlantic zone and an Asiatic-Pacific zone. Relative minima of frequency exist on the leeward side of mountains and near large lakes. Maximum changes of the relative topography 500/1000 mb occurring with coolings or heatings in 24 hours are studied. Seasonal and annual pressure changes on the surface are computed in connection with tropospheric coolings and heatings. With the exception of some areas, coolings are generally accompanied by pressure rise, heatings by pressure drop. Data from 109 stations were analyzed for percentage of tropospheric coolings and heatings and pressure changes. The results shown in this paper can be used for improving forecasting charts, especially in areas where tropospheric coolings are connected with pressure increase, heatings with pressure drop. K.W.

N68-38167# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN RESULTS OF EXPERIMENTAL INVESTIGATIONS OF THE TURBULENCE OF THE ATMOSPHERE WITH HELP OF RADIOSONDES [NEKOTORYE REZULTATY EKSPERIMENTALNYKH ISSLEDOVANII TURBULENTNOSTI ATMOSFERY S POMOSHCHYU RADIOZONDOV]
V. P. Belyaev et al Jan. 1968 68 p refs Transl. from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 54, 1964 p 4-52
(FTD-MT-24-207-67; AD-674218)

A description is given of methods and equipment for measuring air turbulence over Moscow, Sukhumi (Caucasus), and Tashkent (Kazakhstan). One of the noteworthy features of the method is the synchronization of measurements of air turbulence with such parameters as air temperature, humidity, pressure, wind velocity, and wind direction. Turbulence was measured mostly by balloon-borne radiosondes with an A-22-III accelerometer attached. Sufficient data have been collected (457 radiosonde ascents in 1961-62) to determine a turbulence pattern over the aforementioned localities. Turbulence occurs with the highest frequency in the 1-2 km ground layer, it then decreases reaching a minimum at 6-7 km and then reaches a maximum again at 10-12 km. Data were analyzed to determine other turbulence characteristics depending on location, season, altitude, etc. It was noted that turbulence generally depends on thermal and dynamic stratification in the atmosphere and frequently occurs during pronounced vertical wind and temperature gradients. Two turbulent layers are frequently observed: one above the jet stream and one below it. Turbulence is minimal on the jet stream level. It was also observed that over Moscow and Sukhumi the turbulent layer seldom exceeds 200-400 m and only over Tashkent at 5-7 km is it ever more than 1000 m thick. The experimental work was carried out by the Central Aerological Observatory, Moscow. Also cited are turbulence data for the United States and data collected by E. A. Hyde (1954) for air routes from London to the Far East and back, and London to North Africa. Author (TAB)

N68-38176 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 80, NO. 4: DAILY ALTITUDE MAPS OF THE 100 mb LEVEL AND THE 50 mb LEVEL AS WELL AS MONTHLY MEAN MAPS FOR 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 80, HEFT 3: TAEGLICHE HOEHENKARTEN DER 100-MB-FLAECHE UND DER 50-MB-FLAECHE SOWIE MONATLICHE MITTELKARTEN FUER DAS JAHR 1967. TEIL 4,4. VIERTELJAHR] Quarterly Report
Regina Kirch, Barbara Kriester, Karin Labitzke, Wolfgang Roeder, Richard Scherhag et al 1968 130 p refs In GERMAN
(QR-4) CFSTI: HC $3.00

The Berlin Meteorological Institute presents daily aerological measurements charts for the 100 mb and 50 mb atmospheric levels as well as median monthly charts for winter, 1967. Seasonal cooling of the stratosphere and intensification of the polar circulation over the Northern Hemisphere continued at a steady pace. Transl. by G.G.

N68-38177# Army Tropic Test Center, Fort Clayton (Canal Zone).
ENVIRONMENTAL DATA BASE FOR REGIONAL STUDIES IN THE HUMID TROPICS Semiannual Report, Mar.–Aug. 1967
May 1968 105 p refs
(ARPA Order-740)
(SAR-4; AD-674660)

The report for the Environmental Data Base Project presents a review of project objectives and scope, with descriptions of the observational sites, and summarizes project activities during the period of March through August 1967. The Climate section (Part IV) briefly outlines the types of micrometeorological data observed and instrumentation used. A detailed discussion is given of the problem areas encountered in acquiring such data in the humid tropics, together with those solutions that have been evolved. An analysis of the spatial and temporal frequency distributions of temperature and humidity values is presented. The Soils and Hydrology section (Part V) contains interim data on Soils parameters at one satellite site. The Vegetation section (Part VI) consists of an analytical discussion of the floristic characteristics of the Albrook Forest site. The section on Microbiology and Chemistry of the Atmosphere (Part VII) contains a discussion on the concentration of carbon dioxide in the tropical atmosphere, as well as a paper on the microbiological content of rainwater. The Macrofauna subtask of the Project, covered in Part VIII, presents the preliminary results of an insect collection program, carried out at different levels. Author (TAB)

N68-38239# Emmanuel Coll., Boston, Mass. Oriental Sciences Research Library.
THE INFLUENCE OF A MOUNTAIN ON THE DISPLACEMENT OF BAROTROPIC DISTURBANCES
Jung-Sen Wu Bedford, Mass. AFCRL May 1968 17 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 34, no. 2, 1964 p 192–194
(Contracts F19628-68-C-0251; AF 19(628)-5073)
(EMM-66-67; AFCRL-68-0274; AFCRL-TRANS-2; AD-674477)

The paper investigates the influence of a mountain with constant slope on the displacement of barotropic disturbances. The results obtained by Chow and Koo (1958) are discussed in detail. Author (TAB)

N68-38266# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
UTILIZATION OF PAST DATA IN NUMERICAL FORECASTING
Chen-Chao Koo Bedford, Mass. AFCRL May 1968 21 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 29, no. 3, 1958 p 176–184
(Contracts F19628-68-C-0251; AF 19(628)-5073)
(EMM-66-63; AFCRL-68-0273; AFCRL-TRANS-1; AD-674478)

Up to now, past data have not been utilized in numerical weather forecasting due to the particular formulations of the problem. This paper indicates that the condition for solution, formed by a whole set of available meteorological data, is not compatible with the general system of weather equations. Thus, it is necessary to study the best way of formulating the problem using the greatest possible amount of available data in the condition for solution in order to obtain the optimum way of forecasting. Two possibilities are given. First, it is shown that under certain conditions, weather forecasting may be formulated as an evolutionary problem, in which past data are utilized. Secondly, past data could be partly utilized in an initial-value problem in which the system of weather equations, with certain meteorological variables eliminated, contains higher order time derivatives. The significance of these formulations is discussed. Author (TAB)

N68-38281# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
AUTOMATIC PIBAL TRACKING SYSTEM
Willie N. Jacobs May 1968 20 p refs
(ECOM-5196; AD-674180) CFSTI: HC$3.00/MF$0.65

An Automatic Pibal Tracking System has been developed utilizing a T-9 Radar for the tracker. This system provides an efficient means of acquiring wind information to 10,000 feet altitude with an accuracy compatible with Missile Range requirements. By eliminating manual tracking and calculations, a significant reduction in operating personnel is achieved. Author (TAB)

N68-38320# General Dynamics/Convair, San Diego, Calif.
OCEAN DATA STATION SENSOR SYSTEM DESCRIPTION EXPLORATORY DEPLOYMENT CONFIGURATIONS
David L. Berquist Jun 1968 121 p
(Contract Nonr-3062(00))
(GDC-AAX68-003; AD-674410) CFSTI: HC$3.00/MF$0.65

The primary scientific function of Buoys ALPHA and BRAVO during the North Pacific Exploratory Deployment will be to gather meteorological and oceanographic data. The meteorological data requirements for this experiment are wind velocity, ambient air temperature and absolute moisture content at 5, 10 and 15 meters above sea level, as well as rainfall, radiation and barometric pressure. Oceanographic data requirements include surface roughness, current velocity, and seawater surface temperature. Underwater measurements of temperature, depth and conductivity will be made at ten positions along the mooring line to a depth of 500 meters. Author (TAB)

N68-38321# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
COLD REGIONS SCIENCE AND ENGINEERING PART 1: CLIMATOLOGY OF THE COLD REGIONS SOUTHERN HEMISPHERE
C. Wilson May 1968 85 p refs *Its* Cold Regions Sci. and Eng. Mono. No. 1–A3c
(CRREL-CRSE-1-A3C; AD-674185) CFSTI: HC $3.00/MF $0.65

The monograph summarizes the climatology of the cold regions of the Southern Hemisphere which consist almost entirely of the Antarctic Continent. Comparisons with the northern cold regions are followed by a systematic treatment of general circulation, the energy budget, and meteorological elements forming the climate of the region. Thirty-two illustrations (many of several parts) and ten tables give climatological data, and a selected bibliography of 281 items provides complete coverage for further details. Author (TAB)

N68-38350 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 90, NO. 1: RESULTS OF THE ASCENTS OF THE RADIOSONDE STATION, BERLIN-TEMPLEHOF, OF THE INSTITUT FUER METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAT BERLIN, JANUARY 1968 [METEOROLOGISCHE ABHANDLUNGEN. BAND 90,HEFT 1: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION, BERLIN-TEMPELHOF, DES INSTITUTS UNIVERSITAET BERLIN IM JAHRE 1968, JANUAR]
Richard Scherhag 1968 126 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

The detailed results of the radiosonde ascents performed by the aerological station of the Institute for Meteorology and

Geophysics, Berlin, are presented. Using these data monthly time cross sections of the averaged temperature and the zonal and meridional wind components in heights above 30 km were constructed. Extreme and mean values of the temperature, pressure, geopotential, wind data, refractivity, pseudopotential temperature, and velocity of sound were extracted for all standard pressure surfaces, several height levels, the tropopause and the freezing level. The data of the ozone-ascents are given in tabular and graphical form. Author

N68-38375# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Biology and Health Physics Div.

USAEC METEOROLOGICAL INFORMATION MEETING

C. A. Mawson ed. 1967 624 p refs Proc. of Conf. held at Chalk River, Ontario, 11–14 Sep. 1967

(AECL-2787; CONF-670931) Available from Atomic Energy of Can., Ltd., Chalk River: $12.00

A compilation of health physics related papers presented at the USAEC meteorological information meeting is presented. Major areas given consideration include plume rise studies, site evaluations and calculations, gas and particle diffusion and transport studies, spectra investigations, related theoretical papers, scavenging, and particle deposition studies. C.T.C.

N68-38379# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

THE SRL METEOROLOGY SYSTEM

R. E. Cooper and B. C. Rusche *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 51–58 (See N68-38375 24-20)

(Contract AT(07-2)-1)

The facilities used in the Savannah River Laboratory Meteorological Program and operational experience with the program are described. The primary facility being used is a TV tower that is instrumented to a height of 1200 ft. Another tower has instruments to 110 ft. The system, in service for about two years, provides wind speed, wind direction, standard deviation of wind direction, and temperature data once every 3 to 5 min. at each tower. Output data are punched on paper tape in a form suitable for computer processing. The instruments have performed satisfactorily since correction of the initial problems detected during checkout of the equipment. Sensors mounted on the 1200-ft tower are serviced every 3 months unless major damage occurs. The major hazard has been the melting and falling of ice during warm periods of the winter months. No problems due to RF pickup have been encountered at the TV tower. Availability of the equipment has been better than 90% since February 1966. The system is expected to continue in service for about another year. Author

N68-38380# Environmental Science Services Administration, Idaho Falls, Idaho. Air Resources Field Research Office.

RELATIVE DOSE FACTORS FROM LONG-PERIOD POINT SOURCE EMISSIONS OF ATMOSPHERIC POLLUTANTS

George E. Start and Earl H. Markee, Jr. *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 59–78 Prepared for AEC (See N68-38375 24-20)

A new technique for estimating air pollution exposures which result from long-period effluent releases is described. A continuous point source release is approximated by sequential instantaneous point source releases. The total effluent exposure effect of the release is determined from the summed total integrated concentrations from each instantaneous point release. These exposures are expressed as a relative dose factor, the sum of hourly values of total integrated concentration (units-hr/m^3). The new method is particularly useful for calculating relative dose factors in regions in which the winds undergo a marked dirunal cycling. The maximum mixing depth concept is adopted to limit vertical dispersion. As a computational simplification, the fields of atmospheric stability and wind within the boundary layer are assumed to have spatial homogeneity during each hourly computational interval. The technique is illustrated for a continuous, ground-level, point source release of effluent. Author (NSA)

N68-38381# Argonne National Lab., Ill. Radiological Physics Lab.

THE USE OF DATA IN EVALUATING RADIATION HAZARDS ASSOCIATED WITH A REACTOR ACCIDENT

Harry Moses, Mary A. Bogner, and James E. Carson *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 77–86 (See N68-38375 24-20)

Wind speed, wind direction and stability measurements were used to evaluate the hazards associated with an assumed maximum credible reactor accident. Comparison of these results with those based on a constant wind direction, 2 meter per second wind speed and inversion conditions indicates a reduction factor of 10 for a 30-day iodine inhalation dose is reasonable when meteorological conditions are used. Author (NSA)

N68-38382# Environmental Science Services Administration, Idaho Falls, Idaho. Air Resources Field Research Office.

AERODYNAMIC EFFECTS OF THE EBR-2 CONTAINMENT VESSEL COMPLEX ON EFFLUENT CONCENTRATION

C. R. Dickson, G. E. Start, and E. H. Markee, Jr. *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 87–104 (See N68-38375 24-20)

Dispersion measurements of a tracer, uranine dye in solution, were made around a reactor complex to 600 meters from release point, in stable and unstable atmospheres. The tracer was released from the northeast side of the EBR-II reactor containment vessel and sampled at the one meter level by 90 high-volume air samplers. Some 24 releases for 30-minute periods were analyzed. Techniques of dispersal, collection and analysis of the tracer are included. Meteorological measurements during tests included vertical and horizontal wind direction and velocity fluctuations at the six meter level at one upwind and several downwind locations and vertical temperatures at several levels on a 74 meter tower. It was found that the increase of the product of vertical and horizontal turbulence downwind of the structures over that in open terrain could exceed a factor of 15 at 100 meter downwind for 5-minute periods and averaged a factor of 5.0 for 30-minute periods. Author (NSA)

N68-38384# Environmental Science Services Administration, Oak Ridge, Tenn. Atmospheric Turbulence and Diffusion Lab.

SIMPLIFIED ATMOSPHERIC DIFFUSION CALCULATIONS WITH SLIDE RULE GAGE POINTS

Frank Gifford and Robert Waterfield (AEC, Washington, D. C.) *In* Atomic Energy of Can., Ltd., USAEC Meteorol. Inform. Meeting 1967 p 132–135 Supported by AEC (See N68-38375 24-20)

Gage points are given with the help of which the most commonly required atmospheric diffusion calculations can be carried out rapidly using a simple slide-rule setting; e.g., maximum ground concentration, its distance, and the corresponding effective stack height as functions of the prevailing type of meteorological condition. Author (NSA)

N68-38385# Battelle-Northwest, Richland, Wash. Atmospheric Sciences Section.

THE MOUNTAIN IRON DIFFUSION PROGRAM

W. T. Hinds *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform Meeting 1967 p 137–160 (N68-38375 24-20)

A large-scale program designed to illuminate the diffusion characteristics of marine air over coastal range mountains was carried out in Southern California. The experimental design for this program is outlined, and salient features of diffusion analysis are presented. The technique developed for predicting plume width, based on the Hay-Pasquill running average method, indicated that

$\beta = 200/\sigma_\theta$, much larger than heretofore reported for unstable conditions. The prediction of centerline exposures over mountainous terrain was shown to be dependent upon temperature stratification in a different manner than observed over level terrain, and that exposures were generally lower and less dependent upon both season and time of day over mountainous country. Author

N68-38386# Atomic Energy Commission, Washington, D. C.
RADIOACTIVE AIR POLLUTION IN THE 9 D's
J. Z. Holland *In* Atomic Energy of Can., Ltd., USAEC Meteorol. Inform. Meeting 1967 p 161–175 (See N68-38375 24-20)

Device sets the stage for the first act, written by nuclear engineers and physicists, in which Disposal begins the action while Decay gradually closes the curtain. Displacement provides the scene for the second act, written by meteorologists, in which turbulent Dispersion prevails until Deposition (both wet and dry) brings down the curtain. Dose opens the final act, in which the nature of Damage is revealed, and Disappearance ends the play. The attention in this critique is centered on Displacement and Dispersion, their changes of character with varying time and length scales, the deterministic nature of one and the statistical nature of the other, and their relevance to radioactive air pollution. Author (NSA)

N68-38387# Atomic Energy Commission, Las Vegas, Nev. Air Resources Field Research Office.
LONG RANGE TRAJECTORIES
P. W. Allen, E. A. Jessup, and R. E. White *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 176–190 (See N68-38375 24-20)

A statistical analysis is presented of cloud trajectories, including prediction of aerosol cloud paths, reconstruction of the motion of a volume of air, and the possible trajectory prediction error over great distances. Emphasis is placed on information that may help to evaluate the significance of a trajectory endpoint, whether it is predicted, reconstructed from wind data, or obtained from a single tracer. C.T.C.

N68-38388# California Univ., Livermore. Lawrence Radiation Lab.
ATMOSPHERIC DIFFUSION OF LARGE CLOUDS
Todd V. Crawford *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 191–214 Supported by AEC (See N68-38375 24-20)

Clouds of pollutants travel within a coordinate system that is fixed to the earth's surface, and they diffuse and grow within a coordinate system fixed to the cloud's center. This paper discusses an approach to predicting the cloud's properties, within the latter coordinate system, on space scales of a few hundred meters to a few hundred kilometers and for time periods of a few days. A numerical cloud diffusion model is presented which starts with a cloud placed arbitrarily within the troposphere. Similarity theories of atmospheric turbulence are used to predict the horizontal diffusivity as a function of initial cloud size, turbulent atmospheric dissipation, and time. Vertical diffusivity is input as a function of time and height. Therefore, diurnal variations of turbulent diffusion in the boundary layer and effects of temperature inversions, etc. can be modeled. Nondiffusive cloud depletion mechanisms, such as dry deposition, washout, and radioactive decay, are also a part of this numerical model. Author

N68-38389# Toronto Univ. (Ontario).
PLUME RISE AND DISPERSION NEAR THE SHORELINE OF A LARGE LAKE WHEN FLOW PATTERNS ARE DOMINATED BY THE LAKEBREEZE
William J. Moroz and B. Koczkur *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 215–228 Sponsored by the Ontario Dept. of Health (See N68-38375 24-20)

The rise and dispersion rates of plumes from a large thermal generating station located on the Lake Ontario shoreline in relatively flat terrain on the outskirts of a large city are examined under conditions where the local flow patterns are dominated by lakebreeze circulations. For the periods of analysis winds aloft were observed using pilot balloons released over the land near the source and temperature structure in the vertical was observed on both sides of the shoreline using an instrumented light aircraft. The plume was recorded for subsequent analysis using time lapse photographic techniques. Application of special films and filtering devices permitted observations to be extended beyond the point where the plume is no longer visible to the naked eye. Analysis of individual photographs is conducted using a photodensitometer to avoid error through the introduction of subjective interpretations. The position of the plume centerline in space and the vertical spread of the plume were determined under conditions of moderate wind shear in the vertical and a slightly stable lapse rate through the layer of rise and dispersion. Author (NSA)

N68-38390# Environmental Science Services Administration, Silver Spring, Md.
ATMOSPHERIC TRANSPORT AND DIFFUSION AT COASTAL SITES
Isaac Van der Hoven *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 229–240 (See N68-38375 24-20)

On the average overland atmospheric diffusion rates are shown to be three times more rapid than those with overwater trajectories when the water is colder than the air temperatures over the land. The transport distance required to complete the transition from overwater to overland diffusion is shown to be a function of plume height, wind speed, and vertical temperature profile. Diffusion models are suggested to account for the diffusion rates within this transition zone. Coastline atmospheric trajectories are discussed in terms of local effects which result in the daily reversals between land and sea breezes and of large-scale pressure gradient effects which generally result in straight-line trajectories. Author (NSA)

N68-38391# Environmental Science Services Administration, Silver Spring, Md.
MESOSCALE DIFFUSION DERIVED FROM TETROON FLIGHTS
J. K. Angell and D. H. Pack *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 241–251 (See N68-38375 24-20)

A summary is presented of continuous-point-source (CPS) and instantaneous-point-source (IPS) diffusion within the planetary boundary layer as obtained from tetroon flights at Los Angeles, Atlantic City, New York, and Idaho Falls. For downwind distances from 5 to 50 km, the IPS and CPS diffusion is proportional, respectively, to the 0.8 and 0.9 power of distance for the combined data. Over a day, CPS diffusion in the lateral direction is also proportional to release interval (in hours) to the 0.3 power. Based on the classical solution for Fickian diffusion, the coefficient of (horizontal) eddy diffusivity varies from 10^6 to 10^7 cm^2 s^{-1}. With the additional assumption that tetroon diffusion is a result of eddies within the inertial subrange, the dissipation averages 1.0 cm^2 s^{-3}. The variation with time of the square of the separation distances between simultaneously released tetroon pairs is in good accord with similar data, at larger and smaller scales, obtained by other workers. There is some evidence that this separation rate is largest from 5 to 10 minutes after release for pairs initially separated by the order of 100 meters. Author (NSA)

N68-38392# Environmental Science Services Administration, Silver Spring, Md.
DIFFUSION MEASUREMENTS AT MEDIUM RANGE FROM A CONTINUOUS POINT SOURCE

Kendall R. Peterson *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 252–261 Supported by AEC (See N68-38375 24-20)

The structure of the Brookhaven plume on a day with neutral stability was delineated out to distances of about 150 miles downwind from the Brookhaven reactor. A vertical cross-section at 144 n miles from the source showed the plume to be well organized with good vertical mixing giving nearly uniform maximum concentrations to at least 2000 feet. The usefulness of a vertical saw-tooth flight path was verified and is believed to be superior to a number of horizontal passes perpendicular to the plume. Peak concentrations, as observed, decrease by more than two orders of magnitude at a distance of 150 n miles and a travel time of 10 to 12 hours. Peak concentrations corrected for decay appear to decrease by about a factor of 7 to 10 over the same distance and time. The lateral standard deviation of the plume seems to fit an extension of the Pasquill-Gifford "D" curve with distance and is approximately equal in kilometers to 1.2t with time in hours. Author (NSA)

N68-38393# Environmental Science Services Administration, Silver Spring, Md.

MODELING AIR POLLUTION IN THE WASHINGTON, D. C. TO BOSTON MEGALOPOLIS

David H. Slade *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 263–270 (See N68-38375 24-20)

Simplified meteorological models and pollutant source configurations were used to demonstrate the types of pollutant patterns that might be encountered in the Washington, D. C.–Boston megalopolitan corridor. A semirealistic source distribution and source intensity of carbon dioxide were used in this demonstration. The results of the computations suggest that local increases in quantities of pollutants may at times require regional rather than local source consideration. Author (NSA)

N68-38394# Montreal Univ. (Quebec). School of Health.

URBAN HEAT ISLAND AND SULFUR DIOXIDE CONCENTRATIONS: AN AIR POLLUTION PROJECT AT UNIVERSITE DE MONTREAL

Conrad East *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 271–274 Supported by the Dept. of Natl. Health and Welfare of Can. (See N68-38375 24-20)

A study of the problems that air pollution poses to large urban populations is described. A description of the project with emphasis on its goals, instrumentation, and operational techniques is presented. Author

N68-38395# Battelle-Northwest, Richland, Wash. Atmospheric Sciences Section.

REAL TIME SAMPLING OF ZINC SULFIDE TRACER IN DIFFUSION STUDIES

W. L. Dotson, P. W. Nickola, and M. A. Wolf *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 277–291 (See N68-38375 24-20)

A real time sampler has been developed for the measurement of instantaneous atmospheric concentrations of zinc sulfide particulates. The requirements for such an instrument and its subsequent evolution for both surface and airborne applications are presented. Salient features of real time sampler records from several diffusion tests are discussed. The airborne instrument is shown to provide vertical definition of the tracer distribution which is not otherwise available. Comparisons are made of the time-integrated concentrations across the tracer plume, measured by the filter samplers of the Hanford diffusion grid, and the instantaneous cross-plume concentrations defined by the real time samplers. The instantaneous properties of the continuous plume emphasize the local influences which perturb the mean flow, while the relationship of the instantaneous properties to the time-averaged properties provide additional insight into the nature of the instantaneously generated puff. Author

N68-38396# Federal Aviation Administration, Washington, D. C. Systems Analysis Div.

LOW LEVEL WIND AND TEMPERATURE INFORMATION FOR AIRCRAFT OPERATIONS AT AIRPORTS

Arthur Hilsenrod *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 292–306 (See N68-38375 24-20)

The mesometeorological data used in turbulence and diffusion studies can be used to provide information that affect aircraft operations in the terminal area. It includes: wind shear, low level turbulence, conditions that propagate or dissipate aircraft wake turbulence, amount of agent to use in the dissipation of fog, and the propagation of noise. The FAA planned programs in wake turbulence and noise abatement are discussed. Author (NSA)

N68-38397# Sandia Corp., Albuquerque, N. Mex.

DIFOUT: AN ATMOSPHERIC TRANSPORT AND DIFFUSION MODEL

R. E. Luna *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 307–319 (See N68-38375 24-20)

A computer programmed model for prediction of the atmospheric transport and diffusion of aerosols was developed. The program is a melding of a U.S. code describing gravitational fallout of a log-normal size distribution of particles in a vertically-varying wind field and a U.K. code describing the dispersion of a particle cloud by atmospheric turbulence. At its inception the aerosol cloud is approximated by a series of cylindrical layers in the vertical direction characterized by a source strength, lateral diameter and thickness, and a distribution of aerosol mass with particle diameter. In turn, each layer is composed of several line source elements of equi-size particles to conform to the aerosol mass-diameter distribution for the layer. Each element descends at its gravitational fall rate and is transported by the mean vector wind while expanding by the action of turbulent diffusion. Deposition and/or airborne dosage is calculated on a specified circular grid of ranges and azimuths whose origin is at the cloud's initial position. Author (NSA)

N68-38398# Travelers Research Center, Inc., Hartford, Conn.

A COMPUTER PROGRAMMED MODEL FOR CALCULATION OF FALL AND DISPERSION OF PARTICLES IN THE ATMOSPHERE

K. D. Hage and H. W. Church (Sandia Corp., Albuquerque, N. Mex.) *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 320–333 (See N68-38375 24-20)

An atmospheric model has been designed and developed to provide estimates of air concentrations or ground deposit densities of particles released in the atmosphere up to 90-km altitude. Particle density and diameter may range from 1 to 10 g/cm^3 and about 3 to 300μ, respectively, for given instantaneous point or line sources. The particle cloud is allowed to move horizontally in accordance with analytically simulated winds and to fall at terminal velocity plus vertical air velocity. Small-scale cloud growth rate is specified empirically at values based on past instantaneous tracer experiments while large-scale growth results from trajectory subdivision and divergence of new particle trajectories. Some specific computer runs were done to assess hazards resulting from possible rocket abort situations and atmospheric reentry from improper orbits of isotopic or reactor power supplies. The results have been compared with other modes of estimation derived from simpler models of world-wide contaminant spread. While existing data are insufficient for full verification, it is felt that the present model is one of the most comprehensive and realistic available. Author (NSA)

N68-38399# Sandia Corp., Albuquerque, N. Mex.

INVESTIGATION OF TMAE (TETRAKIS (DIMETHYLAMINO) ETHYLENE), A CHEMILUMINESCENT MATERIAL, AS AN ATMOSPHERIC TRACER

R. E. Smith and R. M. Elrick *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 334–346 (See N68-38375 24-20)

TMAE was investigated for use as an atmospheric tracer. Small quantities of TMAE released in the troposphere produced a chemiluminescent cloud whose image was recorded by a light-sensitive TV tracking system. The experiments were conducted primarily to determine the feasibility of using TMAE as a tracer material in field experiments to verify the accuracy of a diffusion and fallout model. It was concluded that TMAE can be used to provide much needed data on the effect of turbulent diffusivities and other meteorological parameters involved in dispersing a cloud of large particles released in the atmosphere. It is also believed TMAE can be used to obtain quantitative information about the ground dispersion pattern which results from the point source release in the troposphere and lower stratosphere of particles 100 to 200 microns in diameter. Author

N68-38400# Brookhaven National Lab., Upton, N. Y.
AN ISOTOPIC RATIO TRACER TECHNIQUE
Maynard E. Smith and Lester A. Cohen *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 347–355 Supported by AEC (See N68-38375 24-20)

The feasibility was investigated of utilizing naturally-occurring differences in the stable isotopes of sulfur as a means of identifying SO_2 and sulfates with the major sources from which they originate. This technique involves sampling of the SO_2 from the atmosphere by a chemically treated filter, a series of chemical conversions, and finally determination of the isotopic ratios in a mass spectrometer. The details of this tracer system and its initial field results are summarized. Author

N68-38401# Argonne National Lab., Ill. Radiological Physics Div.
APPLICATIONS OF CLIMATOLOGICAL MEASUREMENTS
Harry Moses, James E. Carson, W. C. Ashby, Mary A. Bogner, and Frank C. Kulhanek *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 356–367 Supported by AEC (See N68-38375 24-20)

More than 18 years of meteorological data have been collected by the Meteorological Group at the Argonne National Laboratory. These data have been useful in the day-to-day operations of the Laboratory and in the preparation of reactor hazard reports as well as in support of atmospheric research projects, such as radon, wind profile, plume rise and smoke diffusion studies. A climatological report, covering 15 years of data, has been prepared and will be published soon. A summary of the study of the meteorological conditions giving rise to dew point inversions (moisture content increasing with height near the ground) is given as an example of the type of studies that can be made with these data. Author (NSA)

N68-38402# Brookhaven National Lab., Upton, N. Y.
A SUMMARY OF RECENT TURBULENCE MEASUREMENTS AT BROOKHAVEN NATIONAL LABORATORY
J. A. Frizzola, I. A. Singer, and N. E. Busch (Atomic Energy Comm. Res. Estab., Riso, Denmark) *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 368–380 Supported by AEC (See N68-38375 24-20)

A recent analysis of mean gradient and spectral measurements is reviewed. Estimates of the stress derived from mean wind profiles compare favorably with the measured quantity -u'w'. However, some of the assumptions used, particularly the constancy of the stress with height at the Brookhaven site are discussed. Spectral data are presented which indicate the vertical velocity component obeys similarity theory and those spectra agree with some recent suggestions for the shape of the w spectra. The longitudinal and lateral components, u and v, also obey the similarity hypothesis but over a smaller frequency range than the w component. The v component also appears to be more influenced by thermal stratification than the other two components. Finally, the ratio of the vertical velocity variance to the stress fits quite adequately into recent suggestions concerning the shape of the spectra. Author

N68-38403# Argonne National Lab., Ill. Radiological Physics Div.
IN THE INDIRECT MEASUREMENT OF VERTICAL FLUXES NEAR THE GROUND BY VARIANCE REDUCTION ANALYSIS
Paul Frenzen *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 381–390 (See N68-38375 24-20)

Equations are derived for diffusion by continuous movements by relating the mean-square dispersion achieved in one axial direction by the ensemble of particles at a time T after release from a point source, to the mean-square turbulent velocity of the particles and an integral of a Lagrangian autocorrelation function. The autocorrelation function is derived from a record of velocity fluctuations exhibited by a typical particle moving along a trajectory in response to the turbulent field of motion. NSA

N68-38404# Battelle-Northwest, Richland, Wash. Atmospheric Sciences Section.
COMPARISON OF TURBULENCE SPECTRA FROM HANFORD, WASHINGTON AND LIBERAL, KANSAS
C. E. Elderkin *In* Atomic Energy of Can. Ltd. USAEC Meteorol. Inform. Meeting 1967 p 391–398 (See N68-38375 24-20)

The same instrument was used for measuring the three components of the wind at both sites and the same analog computer equipment and techniques were used for analysis of the data, assuring an optimum basis for comparison of turbulence spectra from the two regions which differ considerably in terrain features and vegetation cover. In spite of the differences in physical characteristics of the two sites, the normalized spectral distributions for each of three components have similar shapes at the two sites, demonstrating occurrence of peaks and approaches to the inertial subrange in comparable ranges of normalized wave number. Author

N68-38405# British Columbia Univ., Vancouver.
EFFECT OF HEAT FLUX ON THE ATMOSPHERIC TURBULENCE SPECTRA OVER LAND
M. Miyake and F. Badgley (Washington Univ., Seattle) *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 399–405 (See N68-38375 24-20)

The results of a study conducted at the AEC's Hanford Reservation, Richland, Washington made during one day using a three dimensional sonic anemometer–thermometer for fluctuation measurements, sensitive cup anemometer for wind profiles, and thermocouples for temperature profiles are presented. Other measurements using an ultra-fast response thermal probe and a hot-wire anemometer were made simultaneously but are not reported. The electronic and acoustic components of the sonic device are capable of responding to fluctuations up to hundreds of cycles per second but the length of the sound paths used, 30 cm, limits the meaningful response to about 10 cps, more or less, depending on the wind speed. The sonic instrument was mounted at a height of 4 m, mean winds and temperatures were measured at six heights from .75 to 24 m. The runs were spaced one hour apart and each lasted for about one half hour. The early runs show unstable temperature stratification; run nine was approximately neutral; ten and eleven show stable stratification. Author (NSA)

N68-38406# Brera Astronomical Observatory, Milan (Italy). Geophysics and Meteorology Dept.
A RESEARCH ABOUT THE BOUNDARY ATMOSPHERIC LAYER—AN APPLICATION OF LAIKHTNAM'S METHOD
L. Santomauro *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 405–413 (See N68-38375 24-20)

A program of experimental research on the boundary atmospheric layer on the Po valley is described. The Po valley is characterized by stagnant meteorological conditions, and the land is flat and uniform for a considerable extension, particularly in the Milan area. Radiosondes were used for the experimental part.

These radiosondes were particularly useful for the first atmospheric layers, and therefore, a rather large number of characteristic levels were available for study. Laikhtnam's method was applied to the first research phase; consequently the mean height of the boundary layer was determined both experimentally and by equations. Author (NSA)

N68-38407# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.

MICROMETEOROLOGY AT CRNL—SOME PROBLEMS AND SOLUTIONS

P. J. Barry *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 415–425 (See N68-38375 24-20)

Research in meteorology at Chalk River has mostly been dictated by the needs of Health Physics. Two lines of research are described, one concerns the dispersion of stack gases, the other, the deposition of airborne radioactive contaminants onto the surface of the earth. The weather was disregarded but the effects of changing meteorological conditions were treated as a random variable. Diffusion is described in terms of frequency of occurrence of the effects on the contamination of the atmosphere to which it leads. The effects are represented by the ratio of the air concentration of a contaminant to its source emission rate. The research was conducted in connection with interest in containment and siting of reactors. NSA

N68-38408# Battelle-Northwest, Richland, Wash. Atmospheric Sciences Section.

THE VARIANCE OF AN INCREASINGLY SMOOTHED RANDOM VARIABLE

W. T. Hinds *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 426–436 (See N68-38375 24-20)

The rate of decrease of the variance of a stationary random function with increasing smoothing is examined from the viewpoint of the definition of variance. Assuming the smoothing interval to be small with respect to the length of record, and the variance to be calculated from overlapping running means, it is shown that the variance is related to a smoothing interval. Semiempirical forms are shown to provide a good fit for results from time series of both Gaussian and non-Gaussian distributions, and to yield fair estimates of the autocovariance as a function of lag time. Author

N68-38409# Utah Univ., Salt Lake City.

SOME CHARACTERISTICS OF RELATIVE PARTICLE DISPERSION IN THE ATMOSPHERE'S BOUNDARY LAYER

S.-K. Kao and Larry L. Wendell *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 437–452 (See N68-38375 24-20)

(Contract AT(11-1)-1585)

The vertical, along- and cross-wind components of the relative positions and velocities of tetroon pairs were used to determine the auto- and cross-correlation functions, power- and cross-spectra, as well as the relative displacement tensor. It is found that, for all three components of the relative velocity, the power-spectra are practically coincident in the high frequency range from 1.4×10^{-3} to 5×10^{-3} cps. From the growth rate of the relative separation of particles, the along-, cross-wind and vertical components of the eddy diffusivity are estimated to be 5×10^{7}, 10^{7}, and 10^{6} cm^2/sec, respectively. Author (NSA)

N68-38410# Pennsylvania State Univ., University Park.

A THEORY OF THE EFFECTS OF STABILITY UPON THE WIND PROFILE UNDER CONDITIONS OF INHOMOGENEOUS TERRAIN ROUGHNESS

A. K. Blackadar, P. E. Glass, and H. A. Panofsky *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 453–461 (See N68-38375 24-20)

Whenever a wind (in the atmospheric boundary layer) which is in equilibrium with a surface of a certain roughness passes onto a surface of different roughness, finite intervals in time and space are required for the wind to come into equilibrium with the new surface. The depth of the layer within which the air is undergoing horizontal acceleration increases with increasing distance downwind from the change of roughness under conditions of neutral stratification. For non-neutral conditions of stratification, a perturbation-type theory was developed to describe the effect of non-adiabatic lapse rates on the depth of the accelerated layer. Under conditions of continuity of stress, wind speed, and wind shear at $z = \eta$ (the height of the top of the accelerating layer) the equations of motion are integrated numerically through the accelerated layer. From this integral an expression for $\theta\eta/\theta\alpha$ (where α is the reciprocal of the Monin length) as a function of downwind distance from the change in roughness is obtained. Author (NSA)

N68-38411# British Meteorological Office, Bracknell (England).

MODIFICATION OF THE WIND PROFILE DUE TO CHANGES IN SURFACE ROUGHNESS

B. F. Smith (ESSA, Oak Ridge, Tenn.) *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 463–475 (See N68-38375 24-20)

Equations for the mean wind speed, the turbulent shearing stress and the eddy diffusivity are formulated in terms of height above ground, downwind distance and a surface drag coefficient, applicable to a layer in which the coriolis effects are deemed negligible. One empirical parameter is contained in these equations and it is found that the rate of climb of the so-called internal boundary layer, when air passes from one homogeneous surface terrain to another, depends selectively on this parameter. Experimental data appearing in the literature is at present insufficient to fix the parameter more than roughly. Several numerical experiments were carried out giving ostensibly sensible changes in the wind profile. Modifications to the basic equations, to allow for vertical velocities arising from height changes of the ground and from horizontal retardation of the air, are suggested. Author (NSA)

N68-38412# British Meteorological Office, Bracknell (England).

THE EULERIAN–LAGRANGIAN TIME SCALE RELATIONSHIP IN ONE-DIMENSIONAL TURBULENCE

F. B. Smith (ESSA, Oak Ridge, Tenn.) *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 476–484 (See N68-38375 24-20)

A relation between the two time-scales was found from considerations of particle acceleration which agrees well with experimentally determined values. Two basic assumptions are made: that the rate of change of particle velocity, relative to the mean wind, is due primarily to its transition through the complex turbulent field and not to the local time-distortions of this field; also that the Eulerian and Lagrangian acceleration-correlograms are mathematically similar. Extensions to two and three-dimensional turbulent fields are possible but cumbersome and result in little change in the time-scale relationship. Author (NSA)

N68-38413# Environmental Science Services Administration, Oak Ridge, Tenn. Atmospheric Turbulence and Diffusion Lab.

VARIATION OF THE LAGRANGIAN–EULERIAN TIME SCALE RELATIONSHIP WITH STABILITY

F. A. Gifford, Jr. *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 485–502 Supported in part by AEC (See N68-38375 24-20)

A model of Eulerian fixed-point turbulent velocity fluctuations is combined with the inertial range form of the eddy energy spectrum to find an approximate relation between the Lagrangian and Eulerian fixed-point time-scales involving the eddy energy dissipation rate. This is evaluated by various schemes involving the similarity forms of the surface layer wind profile and the results compared with observed values based on surface layer wind and dispersion measurements. In agreement with data, the

Lagrangian–Eulerian scale ratio, β, is found to vary with stability being equal to 1 to 3 during daytime, unstable conditions and 6 to 12 during nighttime, stable conditions. Author (NSA)

N68-38414# Illinois State Water Survey, Urbana.
TIME DISTRIBUTIONS OF RADIOACTIVITY AND CHEMICAL CONSTITUENTS IN RAINFALL
F. A. Huff and G. E. Stout *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 503–513 (See N68-38375 24-20)

The relationship between the time distributions of radioactivity and selected chemical constituents in rainwater in midwestern U.S.A. is being investigated through comparisons between concentrations of gross beta and Na, K, Ca, and Mg in convective rainstorms. Chemical element concentrations are obtained with a Beckman atomic absorption spectrophotometer and beta counting is made with standard equipment. The data were obtained from a network of automatic rainwater samplers. Author

N68-38415# Berg (T. G. Owe), Inc., Santa Ana, Calif.
HIGH SPEED PHOTOGRAPHY STUDIES OF PARTICLE TRAJECTORIES AND DISTRIBUTIONS IN COLLISIONS WITH WATER DROPS
T. G. Owe Berg, Thomas A. Gaukler, and Urte Vaughan *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 514–526 (See N68-38375 24-20)

An investigation of the washout of atmospheric particulates by rain, especially the effect of electrostatic charges upon the collisions between rain drops and particles is described. The objective was to investigate the high-speed photography technique to determine particle trajectories and distributions. Although the technique is limited with respect to drop size, drop velocity, and particle size, it permits, within these limits, the determination of trajectories of particles of known size and charge. NSA

N68-38416# Battelle-Northwest, Richland, Wash. Mathematical Analysis Section.
PRECIPITATION SCAVENGING OF SUB-MICRON PARTICLES. PART A: THEORY
W. G. N. Slinn *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 527–540 (See N68-38375 24-20)

For the precipitation scavenging of submicron particles, inertial effects are shown to be negligible by transforming Newton's law to the mass independent Smoluchowski equation. The importance of electrical effects can be displayed theoretically but its evaluation requires more specific information about the charges on raindrops and particles. Heat transfer data is utilized to calculate the washout coefficient and the result is found to be a factor of two to ten below Ziman's. Author

N68-38417# Battelle-Northwest, Richland, Wash. Atmospheric Sciences Section.
PRECIPITATION SCAVENGING OF SUB-MICRON PARTICLES. PART B: COMPARISON OF THEORY WITH FIELD EXPERIMENTS
D. I. Hagen *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 541–552 (See N68-38375 24-20)

Calculations based on convective and Brownian diffusion are found to predict within experimental error the rain washout coefficients measured in the field for sub-micron silver iodide particles. These particles, similar to those used in cloud seeding work, have a log normal distribution with geometric mean diameter of .012μ Author

N68-38418# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
TRACERS FOR THE STUDY OF SCAVENGING BY RAIN
A. Nelson Dingle *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 553–566 (See N68-38375 24-20)
(Contracts AT(11-1)-1407; E22-110-67(N))
(Publ.-131)

The study of rain scavenging by means of tracers from crudely defined "natural" sources has led to the idea that the resolution of physical problems of scavenging might be greatly improved by the use of artificially placed tracer. The selection of a suitable material to use in the study of strong convective systems, with measurement by neutron activation is discussed. The design, coordination and execution of a pilot experiment in a strong convective storm at Holdenville, Oklahoma, 30 May 1967 are recounted, and preliminary results of the neutron activation analysis are presented. Although statistics for the evaluation of natural background of the tracer material, indium, are not yet as numerous as desired, and the sample analyses are not all completed, the criterion for success of the pilot experiment, i.e., that the tracer be clearly identified in collected rain samples is certainly met by the preliminary figures. Author (NSA)

N68-38419# Battelle-Northwest, Richland, Wash. Atmospheric Sciences Section.
COSMIC RAY PRODUCED RADIONUCLIDES AS TRACERS OF ATMOSPHERIC PRECIPITATION PROCESSES
N. A. Wogman, C. W. Thomas, J. A. Cooper, R. J. Engelmann, and R. W. Perkins *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 567–580 Presented at the Am. Nucl. Soc. Meeting, Ann Arbor, Mich., 20–22 Mar. 1967 (See N68-38375 24-20)

Some of the long-lived cosmic ray-produced radioisotopes with half-lives greater than one week, have been used as tracers of atmospheric precipitation processes. The shorter-lived radioisotopes with half-lives of minutes to hours have a potential in defining precipitation scavenging mechanisms. Using highly sensitive multidimensional gamma spectrometers, the two short-lived cosmic ray-produced radioisotopes ^{38}Cl and ^{38}S were discovered in rainwater and techniques for the measurement of three other short-lived radioisotopes ^{34m}Cl, ^{39}Cl, and ^{24}Na in precipitation were developed. The technique provides a unique method for studying fallout rates and mechanisms and permits the investigation of processes which cannot be studied by any other method. NSA

N68-38420# Brookhaven National Lab., Upton, N. Y.
EFFECTS OF A FOREST ON PARTICULATE DISPERSION
Gilbert S. Raynor *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 581–588 Supported in part by N. Y. State Museum and Sci. Serv. and AEC (See N68-38375 24-20)
(Grant PHS-AP-81)

A study was conducted which had the following objectives: to determine the behavior of a plume as it approaches the forest edge as a function of release site and meteorological conditions; to determine the dispersion rate within the forest as compared to the rate over open terrain under similar conditions; and to identify the mechanisms important in the removal of particles from the air within the forest. The study area consisted of a fairly dense pine forest with trees about 11 m tall. Four principal effects were attributed to the forest: the plume broadened both horizontally and vertically by divergence of the wind at the forest edge; particles tended to penetrate at tree trunk height or to rise above the canopy; loss of particulates occurred mainly in two stages and by two mechanisms, impaction near the forest edge and deposition well within the forest; and total loss of particulates over the distance studies was considerably greater than over open terrain. NSA

N68-38421# Environmental Science Services Administration, Idaho Falls, Idaho. Air Resources Field Research Office.
TURBULENT TRANSFER CHARACTERISTICS OF RADIOIODINE EFFLUENTS FROM AIR TO GRASS
Earl H. Markee, Jr. *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 589–601 (See N68-38375 24-20)

A total of 20 controlled field releases of radioiodine were performed at the National Reactor Testing Station in Idaho as a portion of a program to study the transmission of gaseous radioiodine through the air-vegetation-cow-milk-human chain. Most of the releases were conducted over typical pasture grasses during different wind and stability conditions. Radioiodine adherence to grass and carbon plates was measured during most of the tests. Vertical air concentration profiles and turbulence parameters were measured to determine flux characteristics. Analysis of the data revealed the complex interdisciplinary nature of transfer of radioiodine from air to a natural surface. The data are in reasonable agreement with the deposition models of Sheppard and Chamberlain when corrections for the physical and biological receptiveness of the grass and grass density are made. The average ratios of momentum to mass flux were found to be 0.9 in stable conditions and 1.4 in unstable conditions. Author (NSA)

N68-38422# Environmental Science Services Administration, Idaho Falls, Idaho. Air Resources Field Research Office.
A PARAMETRIC STUDY OF GASEOUS PLUME DEPLETION BY GROUND SURFACE ADSORPTION
Earl H. Markee, Jr. *In* Atomic Energy of Can., Ltd. USAEC Meteorol. Inform. Meeting 1967 p 602–614 (See N68-38375 24-20)

Total plume depletion by ground surface adsorption was calculated via the one dimensional parabolic diffusion equation. Solutions of this differential equation were obtained by digital computer for sets of eddy diffusivity (K) and wind velocity (u) profiles representative of stable, neutral and unstable conditions. Calculations were made for perfect sink and typical partial sink boundary conditions at ground level to a distance of 10^5 m from the source for various source heights. This method of estimating plume depletion was found to be extremely sensitive to K values in the lower levels and source height. The resultant vertical concentration profiles from a depleting plume show markedly non-gaussian distributions with the height of the maximum concentration increasing with travel distance. This departure from the gaussian distribution is most pronounced in stable conditions. It appears that this parabolic diffusion equation provides realistic vertical concentration profiles and, consequently, reasonable plume depletion estimates. Author (NSA)

N68-38447# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
ON THE STABILITY AND CONVERGENCE OF THE SO-CALLED FORWARD AND CENTERED FINITE-DIFFERENCE SCHEMES FOR EQUATIONS OF THE FORM THE PARTIAL DERIVATIVE OF ZETA WITH RESPECT TO T PLUS U TIMES THE PARTIAL DERIVATIVE OF ZETA WITH RESPECT TO X EQUALS 0
Tung-Hsien Liao. Bedford, Mass. AFCRL. May 1968 20 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 34, no. 4, 1964 p 468–474
(Contracts F19628-68-C-0251; AF 19(628)-5073)
(EMM-66-134; AFCRL-68-0290; AFCRL-TRANS-6; AD-674479)

With a view to solving equations of the form the partial derivative of zeta with respect to t + u the partial derivative of zeta with respect to x = 0 this paper first presents a discussion on the stability of the so-called forward and centered finite-difference schemes under general circumstances and specifies the conditions for stability. The results are found to be different from those given by conventional techniques using centered differences. Three types of finite-difference schemes are compared, and the analysis indicates that the widely used conventional system which employs forward finite-difference for the first time step and centered finite-difference for the rest of the computations gives the worst results, and is computationally unstable when lambda(= delta t/delta s) approaches 1-0.* This difficulty may be overcome by replacing the forward finite-difference operations by the procedure of any one of the other two schemes. Furthermore, better results may be achieved by the introduction of an upwind analogue in the second and the third scheme. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-37730# Joint Publications Research Service, Washington, D.C.
RADIO ALTIMETERS AND INTERCEPT RADAR
G. I. Yermolayev et al 9 Oct. 1968 116 p Transl. into ENGLISH from the book "Osnovy Radiolokatsii i Radiolokatsionnoye Oborudovaniye Letatel'nykh Apparatov" Moscow, Mashgiz., 1967 p 208–296
(JPRS-46626)

CONTENTS:
1. FUNDAMENTALS OF RADAR AND RADAR EQUIPMENT FOR AIRCRAFT. CHAPTER 4: RADIO ALTIMETERS p 1–28 (See N68-37731 24-21)
2. FUNDAMENTALS OF RADAR AND RADAR EQUIPMENT FOR AIRCRAFT. CHAPTER 5: INTERCEPT AND SIGHTING RP-1 RADAR p 29–112 (See N68-37732 24-21)

N68-37731# Joint Publications Research Service, Washington, D.C.
FUNDAMENTALS OF RADAR AND RADAR EQUIPMENT FOR AIRCRAFT. CHAPTER 4: RADIO ALTIMETERS
In its Radio Altimeters and Intercept Radar 9 Oct. 1968 p 1–28 1 ref (See N68-37730 24-21)

Design concepts and operating principles of low altitude RV-2 FM radio altimeters, and high frequency radio altimeters are discussed. S.C.W.

N68-37732# Joint Publications Research Service, Washington, D.C.
FUNDAMENTALS OF RADAR AND RADAR EQUIPMENT FOR AIRCRAFT. CHAPTER 5: INTERCEPT AND SIGHTING RP-1 RADAR
In its Radio Altimeters and Intercept Radar 9 Oct. 1968 p 29–112 2 refs (See N68-37720 24-21)

Basic tactical specifications and operating principles of the RP-1 intercept and sighting radar are discussed. The RP-1 radar coupled with an optical sighting unit designated ASP-3NM is designed to (1) find targets in the front hemisphere within the range of the angles ± 60° with respect to azimuth and ± 26° to −14° with respect to the angles of elevation relative to the longitudinal axis of the aircraft at distances to 12 km; (2) guide an aircraft to its target by an indicator screen with the added advantage of selecting the most advantageous attack direction; (3) automatic input the target coordinates range, azimuth, and angle of elevation both in and without the presence of optical visibility to the optical firing sight ASP-3NM at distances up to 2000 meters (the intercept mode); and (4) determine the country to which the detected aircraft belongs using recognition equipment signals. S.C.W.

N68-37734*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
SIGNAL PROCESSING IN A SATELLITE RADAR ALTIMETER
Charles F. Price Aug. 1968 67 p 6 refs
(Grant NGR-22-009-262)
(NASA-CR-97308; RE-48) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Certain problems in obtaining accurate altitude measurements over the ocean surface from a satellite pulsed radar altimeter are considered. Particular attention is directed toward eliminating sources of bias errors that have the same order of magnitude as the ultimate desired resolution accuracy. Both narrow beam and gated wide beam radars are investigated. The discussion includes criteria for selecting the radar beam width and pulse repetition frequency, for geometrical correction of the beam's spherical wavefront, for altitude estimation equations, and for analysis of estimation performance. Author

N68-37931# Instituto y Observatorio Astronomico de Marina, San Fernando (Spain).
NAUTICAL ALMANAC, 1969 [ALMANAQUE NAUTICO, 1969]
1968 472 p In SPANISH
CFSTI: HC $3.00/MF $0.65

An ephemeris tabulating the 1969 Greenwich hour angles for the first point of Aries, planets, sun, and moon is presented. Tabulations are for hourly increments. Correction and conversion tables and instructions for Local Civil Time computation are included. Transl. by F.O.S.

N68-38017# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AEROSPACE VEHICLE NAVIGATION SYSTEMS
V. P. Seleznev et al Dec. 1967 142 p refs Transl. into ENGLISH from Sistemy Navigatsii Kosmich. Letatelnykh Apparatov (Moscow), 1965 p 1-208
(FTD-MT-24-146-67; AD-674319) CFSTI: HC $3.00/MF $0.65

This book is intended for all personnel engaged in aeronautics, for aeronautics schools, and for general readers interested in space navigation. It systematically discusses the navigational systems used aboard aerospace vehicles and in ground centers, classifies such systems, and describes the progress being made in navigation engineering. Stress is laid on the importance of reliability and accuracy of instrumentation and devices, the automatic reaction of devices to environmental conditions, solar mechanics, and astronomy. Author (TAB)

N68-38065# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
MODEL 1057A TRUE AIRSPEED DATA CONVERTER TYPE CV-2371/AYN-1 Production Test
H. D. Rossin 4 Jun. 1968 206 p
(Contract TCG-13001-A)
(Rept.-1057-011; AD-674773) CFSTI: HC $3.00/MF $0.65

This report presents certified test data obtained during a Preproduction Test Program conducted on the AYN-1 True Airspeed Data Converter. Author (TAB)

N68-38157# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIGITAL DIFFERENTIAL ANALYZER "NAVIGATOR" [TSIFROVOI DIFFERENTSIALYNI ANALIZATOR "NAVIGATOR"]
A. A. Gurakov et al Nov. 1967 14 p refs Transl. into ENGLISH from the book "Vychislitel'naya Tekhnika V Upravlenii" Moscow, Izd. AN SSSR, 1966 p 127-133
(FTD-HT-23-965-67; AD-674343) CFSTI: HC $3.00/MF $0.65

A navigational digital differential analyzer for use in aircraft is described. Such an instrument is particularly suitable for airborne applications because of its simplicity and the possibility of direct hookup with many sensors and transducers used for flight control: accelerometers, gyros, doppler velocity and angle detectors, position coordinate calculators, and various feedback devices from aircraft control mechanisms. The digital differential analyzer can be used as on-board computer if the flight trajectory is predetermined or programmed before takeoff. If the flight path is subject to in-flight variations (piloted aircraft), the DDA should be supplemented by a computer which adds considerable flexibility to the system. For instance, in a transport aircraft, the DDA can continuously compute the navigational data, while the computer, in intervals of 30-40 minutes can correct the navigational data and determine flight conditions for minimum fuel consumption. The DDA consists of a numerical information memory, increment memory, integration unit, data input unit, and an output unit. All logic is based on ferrite core transistor elements. Each functional block is described in detail and design and performance data are given. TAB

N68-38268# Massachusetts Univ., Amherst. School of Engineering.
AN ERROR ANALYSIS TECHNIQUE FOR INERTIAL NAVIGATION SYSTEMS AND KALMAN FILTERS
C. E. Hutchinson and H. M. Wondergem Sep. 1968 91 p refs
(Contract N00014-68-A-0146)
(THEMIS-UM-68-2; AD-674526)

This report develops a method for analyzing the errors incurred in optimum estimation schemes. The optimum control law for modern control systems is usually a function of all the states of the system. In many practical cases it is necessary to extract information concerning the states from the measurement of the output. This extraction process is called estimation. Due to random measurement noise and the random noise components of the states of the system, the estimate of the states is not perfect. A set of computer programs has been developed that provides a way of evaluating optimum and sub-optimum Kalman estimation techniques. The random noise processes have been described in a statistical manner, in order to specify the random noise quantitatively as a function of time. Author (TAB)

N68-38306*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A NAVIGATION AND TRAFFIC CONTROL TECHNIQUE EMPLOYING SATELLITES. VOLUME 5: ADDENDUM. TRAFFIC CONTROL DATA LINKS Final Report
Art Garabedian Oct. 1968 40 p refs
(Contract NAS12-539)
(NASA-CR-86112; TRW-08710-6012-R005) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Data links to provide full duplex communications between NAVSTAR system users and ground stations are considered in terms of air traffic control (ATC) capability for the satellites. Operating at L band, these data links can use the same antennas as for navigation purposes and are considered to have the estimated surveillance requirements of a four-satellite ATC system for the 1975 time period in the North Atlantic area. Each aircraft would periodically transmit latest NAVSTAR range data to a ground station, where a computer would determine aircraft positions and relay this information back to the aircraft. Traffic control links and communications equipment required for ground stations, aircraft, and satellites are described; and estimated data requirements for surveillance and link power budgets are given. The satellite tracking data relay function and the impact on the satellite of adding the increased communication for traffic control are discussed. User hardware costs to implement the traffic control communications are estimated, assuming a production run of 200 units. M.W.R.

N68-38472# Federal Aviation Administration, Washington, D. C. Systems Research and Development Service.
GOALS, ACHIEVEMENTS, TRENDS, 1 JULY 1967–30 JUNE 1968
1968 259 p
(AD-674412) CFSTI: HC $3.00/MF $0.65

This report is intended to serve the needs of SRDS management and the interests of agency Services, Offices, Regions, Centers concerned, and the aviation community. It covers SRDS progress for the period from July 1, 1967 to June 30, 1968. It reports on selected System Modernization Category Program Elements and Subprograms as described in the SRDS FY 1968 Technical Program Document. Selected In-Service Improvement and Long Range Category Subprograms are also reported when they involve efforts of particular interest. Reports on items which are related to approved Development Project Plans are so identified, as is the source of the requirement for each effort. The material in this report is presented in separate chapters for each of the SRDS technical development divisions; i.e., ATC, Communications, Navigation, Environmental, Frequency Management, and Systems Analysis divisions. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-37434# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PROCESS FOR THE DISSOLUTION OF ALUMINUM CLAD THORIA FUEL ELEMENTS
J. F. Phillips and H. D. Huber 1 Aug. 1968 36 p 22 refs
(Contract AT(45-1)-1830)
(BNWL-240) CFSTI: HC $3.00/MF $0.65

In an effort to develop a process for simultaneous dissolution of thoria and its C-64 aluminum alloy container, the following properties were measured: activation and dissolution characteristics of C-64 aluminum in mercury-catalyzed nitric acid-nickel (II) nitrate solutions; thoria dissolution rates in nitric acid-hydrogen fluoride-aluminum nitrate-thorium nitrate solution; and the solubility of thorium nitrate in nitric acid-aluminum nitrate. On the basis of the data obtained, the following codissolution process was recommended: activate and dissolve the containers in 10.0M HNO_3–0.045M HF, 0.10M $Al(NO_3)_3$, 0.0120M $Hg(NO_3)_2$, 0.04M–0.05M $Ni(NO_3)_2$; and when the aluminum is partially dissolved add additional HNO_3–HF solution and dissolve the now-exposed thoria to 0.55M–0.65M $Th(NO_3)_4$. Author (NSA)

N68-37437 Cornell Univ., Ithaca, N. Y.
INVESTIGATION OF SPACE DEPENDENT FAST FISSION RATIOS, AND MEASUREMENTS OF FISSION FRAGMENT RECOIL RANGES IN ALUMINUM
David Justin Osias (Ph.D. Thesis) 1967 147 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-3514

Space dependent values of δ-28 (U-238 to U-235 fission ratio) are measured in two cores of the 2.1% enriched UO_2 light water moderated critical facility. Measurements are also made in an isolated 0.600" diameter fuel rod in a purely thermal flux. Heterogeneous finite lattice calculations are made with different cross section sets to investigate cross section uncertainties. The U-238 cross sections recommended by the Atomic Weapons Research Establishment produce agreement of the calculations with the measurement of δ-28 in a single fuel rod (δ-28 0.0150 ± .0003), and because σ_{inel} has little effect on this calculated value, the agreement indicates an integral accuracy for σ_f of about 2%, which is the accuracy of the isolated rod experiment. Dissert. Abstr.

N68-37451# Atomics International, Canoga Park, Calif.
HIGH HEAT FLUX HEATER DEVELOPMENT Status Report
R. L. McKisson and E. L. Babbe 15 Jun. 1968 38 p 2 refs
(Contract AT(04-3)-701)
(AI-AEC-12681) CFSTI: HC $3.00/MF $0.65

The development of a high heat flux heater for use in corrosion rate and stress rupture tests of fuel cladding materials in a sodium environment is described. The heating unit consists of a graphite rod, 1/8-in. in diameter and 2 in. long, in which up to 3.77 kw of electrical energy is dissipated. A boron nitride sleeve is used as the primary electrical insulator for the graphite, and the heater sheath is made of Type 304 stainless steel. Heat fluxes of 1.3×10^6 Btu/hr-ft^2 have been attained at the heater sheath for periods exceeding 1000 hours. Heater operation and failure modes are discussed, and methods of increasing heater life are described. Author (NSA)

N68-37468# Mound Lab., Miamisburg, Ohio.
DETERMINATION OF PARTS-PER-MILLION QUANTITIES OF PLUTONIUM-236 IN PLUTONIUM-238
W. H. Smith, F. K. Tomlinson, D. W. Eppink, and G. R. Hagee 5 Jul. 1968 23 p 10 refs
(Contract AT(33-1)-GEN-53)
(MLM-1486) CFSTI: HC $3.00/MF $0.65

Two methods for the determination of ppM quantities of ^{236}Pu in ^{238}Pu plutonium dioxide are compared. One method involves the direct measurement of the ^{236}Pu while the other method involves an indirect measure of the ^{236}Pu content of the material. The direct method consists of alpha pulse height analysis of a $^{238}PuO_2$ sample deposited on a thin metal slide. The indirect method consists of the radiochemical determination of the ratio of the concentration of the daughter products of ^{236}Pu and ^{238}Pu (i.e., ^{232}U and ^{234}U.) Author (NSA)

N68-37478# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
EXPERIMENT DESCRIPTION AND HAZARDS EVALUATION FOR THE PACIFIC NORTHWEST LABORATORY MIXED OXIDE (URANIUM OXIDE-PLUTONIUM OXIDE) IRRADIATIONS IN EBR-2 TASK 1 IRRADIATIONS
J. E. Hanson Jul. 1968 190 p
(Contract AT(45-1)-1830)
(BNWL-650) CFSTI: HC $3.00/MF $0.65

A description is given of the proposed program for irradiations in EBR-II of 19-capsule Fast Test Reactor (FTR) fuel subassemblies. The purpose and objectives of the program are: (1) to obtain preliminary fast flux irradiation experience at intermediate and approximately goal exposures with principal candidates for the FTR driver fuel; (2) to obtain irradiation performance data on fuel specimens containing a reference design axial fuel motion restrictor; (3) to obtain fuel specimens irradiated in a fast flux for subsequent evaluation of the fuel and cladding transient performance through irradiation in TREAT, and (4) to provide irradiation experience with fuel specimens whose cladding thickness has been reduced to simulate pessimistic end of life conditions. Fuel to be used is hypostoichiometric mechanically mixed 25% PuO_2–75% UO_2 sintered in a hydrogen atmosphere at 1550°C for 4 hours to yield pellet densities of 90 to 96% TD. Cladding for the fuel pins is Type 304 stainless steel. Design, fabrication, and performance predictions for the fuel specimens, capsules, and subassemblies and a hazards evaluation of the irradiations are presented. NSA

N68-37481# Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group.
THERMOELECTRIC LEG PRODUCT SPECIFICATION (TELPS). VOLUME 1: TECHNICAL RESULTS, PART 2 Final Technical Report
Johathan Black Philadelphia, Pa. GE 15 Oct. 1967 282 p Prepared for GE, Philadelphia, Pa.
(Contract AT(30-1)-3535)
(MMM-8406-1757, V. 1, Pt. 2; Doc.-6300, 262, V. 1, Pt. 2) CFSTI: HC $3.00/MF $0.65

A test program was conducted to determine the steady-state ingradient resistance and voltage characteristics of a large statistical sampling of production SNAP-27 N- and P-type thermoelectric legs over an extended period of time (>2000 hr). The variance of the long-term ingradient performance was analyzed. NSA

N68-37494# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NEUTRON FLUCTUATIONS AT FULL POWER
James R. Sheff 15 Jul. 1968 17 p 7 refs Presented at Reactor. Noise Sem., Tokyo, Sep. 1968
(Contract AT(45-1)-1830)
(BNWL-SA-2003) CFSTI: HC $3.00/MF $0.65

The theory of neutron fluctuations in a nuclear reactor operating with feedback effects is developed. The principal method used was the Langevin approach which was extended to allow iterative solutions of the nonlinear feedback equations. The theory was applied to one and two feedback coefficient models, and calculated results are shown for the first order solutions which result from a particularly desirable linearization of the equations. It is shown that to first order the feedback spectra can be written as being proportional to the modulus squared of the feedback transfer function plus corrections. As a direct result of the insight provided via the Langevin approach, a particular linearized solution to the probability balance set of equations was also obtained again verifying the transfer function modulus squared concept. Author (NSA)

N68-37509# Stanford Linear Accelerator Center, Calif.
A NEW DETECTOR FOR RELATIVISTIC PARTICLES
M. P. Lorikyan 1968 4 p 5 refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Ser. Fiz. (USSR), v. 2, 1967 p 376-379
(SLAC-TRANS-84) CFSTI: HC $3.00/MF $0.65

A single-particle detector in which use is made of KCl and CsI films and either an electron multiplier or solid-state detector for secondary-electron emission is described. NSA

N68-37515# Idaho Nuclear Corp., Idaho Falls.
APPLICABILITY OF CONVENTIONAL PROTECTIVE COATINGS TO REACTOR CONTAINMENT BUILDINGS
B. J. Newby Jun. 1968 75 p 8 refs
(Contract AT(10-1)-1230)
(IN-1169) CFSTI: HC $3.00/MF $0.65

Commercially available protective coatings were tested for their applicability in the containment buildings of boiling and pressurized water power reactors with particular emphasis on conditions present after a loss-of-coolant nuclear accident, such as the LOFT. Characteristics evaluated included resistance to pressurized steam, radiation, abrasion, and chemical decontaminating reagents; elasticity; ease of decontamination from fission products; and compatibility with aged primers. Coatings possessing desirable values for these characteristics were found; the complete results of the evaluations are reported. Author (NSA)

N68-37527# Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group.
THERMOELECTRIC LEG PRODUCT SPECIFICATION. VOLUME 1: TECHNICAL RESULTS, PART 1 Final Technical Report
J. D. Richards Philadelphia, Pa. GE 15 Oct. 1967 282 p Prepared for GE, Philadelphia, Pa.
(Contract AT(30-1)-3535)
(MMM-8406-1757, V. 1, Pt. 1; Doc.-6300-262, V. 1, Pt. 1) CFSTI: HC $3.00/MF $0.65

A program was conducted to resolve the question of variation of leg performance with time and performance. Tests were performed on N-type PbTe and P-type PbSnTe thermoelectric legs from SNAP-27 Phase II production batches. This volume contains a description of the test specimens (test records, comparison of lot production, etc.), material characterization tests, short-term ingradient testing, variance analysis of short-term performance tests, and thermoelectric properties (S, K, and ρ). NSA

N68-37563# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
PERFORMANCE OF A CENTRIFUGAL MIXER-SETTLER AS A PHASE SEPARATOR
C. B. Goodlett Jun. 1968 28 p 7 refs
(DP-1140) CFSTI: HC $3.00/MF $0.65

A single centrifugal mixer-settler used as a separator provides endstreams containing less than 0.5% entrainment when fed a thoroughly mixed emulsion at feed rates up to 25-30 gpm. The capacity of the unit exceeds 40 gpm if the phases are partially settled prior to feeding the separator. Author (NSA)

N68-37568# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).
PILOT SCALE STUDIES ON DISSOLUTION PROCESSES FOR NUCLEAR FUELS. 2: ALUMINUM, MAGNESIUM, STAINLESS STEEL DECANNING, AND NON-IRRADIATED URANIUM METAL DISSOLUTION TESTS IN A PILOT RECIRCULATION DISSOLVER
A. Hasler, J. Centeno, Y. Marchani, and R. Van Eylen Sep. 1967 82 p 15 refs
(ETR-207; NP-17542)

A detailed description of a half-scale pilot dissolver is given. The results of four series of runs including aluminum, magnesium, and stainless steel decladding and dissolution of nonirradiated uranium metal are summarized and discussed. The reaction rates measured in the pilot dissolver and those obtained in laboratory equipment were in agreement. Means for instantaneous measurement of the reaction rate were demonstrated successfully. Uranium metal dissolution with independent recovery of nitric acid and recycling of the recovered nitric acid to the dissolver was carried out and the suitability of automatic O_2 supply control systems for oxidizing NO are discussed. Some border problems connected with the operation of a dissolution unit, i.e., corrosion, liquid circulation, reaction control, and prevention of explosion risk are also considered. The general conclusion was, that for similar development work, the use of large-scale equipment constructed in expensive stainless steel can be avoided and that enough information could be provided by using a very simplified full-scale pilot unit constructed in cheap material and simulated fuel materials and dissolution reagents that do not cause severe corrosion. Author (NSA)

N68-37570# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
IRRADIATION OF FUEL ELEMENTS WITH CENTRAL TEMPERATURES ABOVE THE MELTING POINT OF URANIUM DIOXIDE [BESTRAHLUNG VON BRENNELEMENTEN MIF Z ENTRALTEMPERATUREN OBERHALB DES SCHMELZPUNKTS VON UO_2]
1967 19 p 2 refs In GERMAN; ENGLISH summary Presented at the Intern. Colloq. of the Inst. for Reactor Mater., Julich, W. Ger.
(CONF-670967-1) CFSTI: HC $3.00/MF $0.65

The irradiation experiments with sintered pellet rods are described and discussed. The most important results of the post-irradiation examination, dimensional changes, fission gas release, and microstructural changes are outlined and evaluated. Author (NSA)

N68-37573# Japan Atomic Energy Research Inst., Tokyo.
MERITS OF THE NONLINEAR-SCALE PERIOD METER IN COMPROMISING SCRAM-DELAY AND FLUCTUATION
Tomozo Furukawa and Naoaki Wakayama Feb. 1968 8 p 1 ref Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 8, 1966 p 486-489
(NSJ-TR-101)

A description is made of the relationship between the fluctuation caused by the process of detection of the neutron flux during the normal operation and the response or delay time to the trip action of the excessively short period in the nonlinear period meter , which has a larger gain in the range of normal period for starting-up the reactor and a smaller gain in the range of abnormally short period. This type of period meter is shown to be convenient for the operator in reading the scale in the range of normal operation, and in addition it has an advantage over the conventional period meter in the compromise of fluctuation and trip-delay. Author (NSA)

N68-37579# Los Alamos Scientific Lab., N. Mex.
ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) Quarterly Status Report, Period Ending 30 Apr. 1968
Jul. 1968 19 p refs
(Contract W-7405-ENG-36)
(LA-3965-MS) CFSTI: HC $3.00/MF $0.65

A status report on the Ultra High Temperature Reactor Experiment (UHTREX) for the period ending April 30, 1968 is presented. Experiments reported included: (1) control rod calibration and critical mass of the Los Alamos turret reactor; (2) reactivity experiments, including the effects of core rotation and nitrogen flush; (3) effects of core temperature on critical mass; and (4) instrumentation for reactivity measurements and control rod settings. Nitrogen, air, and helium coolants were compared for their effects on core reactivity. Author (NSA)

N68-37636# Atomics International, Canoga Park, Calif.
NUCLEAR SPACE POWER SYSTEMS
H. M. Dieckamp Sep. 1967 388 p refs
(AI-Memo-7585)

The history, developmental status, and potential applications of nuclear units in the Systems for Nuclear Auxiliary Power (SNAP) program are reviewed. Reactor space power systems are examined from the selection of the reactor and heat rejection systems through power conversion system design and vehicle integration. Development and operation experience with SNAP 2, 8, and 10 is summarized. Radioisotope space power systems design and application factors discussed include: radioisotope selection criteria, radioisotope capsule design, and design characteristics of radioisotope systems for manned and unmanned space missions. NSA

N68-37737# Sandia Corp., Albuquerque, N. Mex.
INTERRELATION OF TWO DETECTORS IN A NUCLEAR REACTOR [INTERCORRELATION DE DEUX DETECTEURS DANS UN REACTEUR NUCLEAIRE]
Abdi Dalfes et al 1967 51 p refs Transl. into ENGLISH from the French report CEA-R-3221
(SC-T-68-1532) CFSTI: HC $3.00/MF $0.65

Auto and cross-correlation functions of signals given by neutron detectors situated in a subcritical nuclear reactor are determined by a numerical method. Values of the prompt neutrons decay constant obtained by means of the autocorrelation function of each detector and the cross-correlation function of the two detectors are compared to the reference value given by a classical pulsed neutrons measurement. Agreement between results is satisfactory. Author (NSA)

N68-37739# Bettis Atomic Power Lab., Pittsburgh, Pa.
EVALUATION OF THE IRRADIATION BEHAVIOR OF A ZIRCALOY-4 CLAD ROD CONTAINING LOW DENSITY UO_2 FUEL PELLETS (LWBR/LSBR DEVELOPMENT PROGRAM)
J. E. McCauley, P. W. Patterson, R. C. Daniel, and H. B. Meieran Jan. 1968 75 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-596) CFSTI: HC $3.00/MF $0.65

A Zircaloy-4-sheathed, rod type fuel element containing low density (≈81.4% of theoretical) UO_2 fuel pellets was irradiated to a peak average depletion of 13.5×10^{20} fissions per cubic centimeter of fully dense fuel at an estimated peak pellet temperature of 2710°F. The specimen was removed from the reactor at approximately 50% of design lifetime in order to evaluate the fuel and cladding irradiation-induced changes in the absence of the complicating effects usually associated with in-reactor specimen failure. Extensive dimensional and metallographic evaluation indicated that at that point in lifetime, the fuel swelling was totally accommodated within the void internal to the oxide pellet. Within measurement error, no external dimensional changes were observed that could be related to fuel swelling. Corrosion weight gain and hydrogen uptake in the cladding were in agreement with behavior anticipated from out-of-pile, static autoclave tests. Reasonable agreement was obtained between measurements and calculations of fuel and cladding deformation as a function of irradiation lifetime. These calculations were performed with the analysis method incorporated in the CYGRO-2 digital program. The material properties and other input parameters and assumptions are presented in detail. Author (NSA)

N68-37769# Oak Ridge National Lab., Tenn.
HIGH FLUX ISOTOPE REACTOR Quarterly Report, Jan.-Mar. 1968
R. V. McCord and B. L. Corbett 10 Jul. 1968 22 p
(Contract W-7405-ENG-26)
(ORNL-TM-2295) CFSTI: HC $3.00/MF $0.65

An operations history of the HFIR is given. Spurious Single-channel trips from the safety systems are tabulated. Maintenance and changes in the process systems are listed. Water analyses and demineralizer data are given. NSA

N68-37771# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
HETEROGENEOUS METHODS IN NEUTRON TRANSPORT THEORY
V. C. Boffi and V. G. Molinari 1968 38 p, 17 refs
(RT/FI(68)30) CFSTI: HC $3.00/MF $0.65

A new method for solving the BOLTZMANN integro-differential equation governing the monoenergetic neutron flux distributions in heterogeneous systems is presented. Three different cases of heterogensity are discussed according to the nature of the kernel of the linear integral equation which defines the FOURIER transform of the total flux. The result for the solution of the given integral equation is then inverted to give the original distributions as function of space and angle. Author

N68-37777# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
JASON: A REACTOR CELL CODE IN FORTRAN II OR IV
R. T. Thompson Sep. 1967 54 p
(Contract AT(45-1)-1830)
(BNWL-482) CFSTI: HC $3.00/MF $0.65

JASON is a derivative of the lattice physics code IDIOT, altered to furnish input data required by the ALTHAEA burnup

code. It calculates the thermal neutron flux fine structure with the P3 approximation to the Boltzmann transport equation for a system of concentric cylinders limited to 16 regions. Input-output format is shown. A sample problem is solved. Author (NSA)

N68-37821# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.

SUPERCRITICAL TECHNOLOGY PROGRAM Final Topical Report, 6 Apr. 1964–15 Apr. 1965

J. F. Patterson, comp. May 1968 236 p refs

(Contract AT(30-1)-3374)

(WCAP-3374-8) CFSTI: HC $3.00/MF $0.65

The objectives of the supercritical technology program were to: (1) Build and install a supercritical water-cooled, in-pile, fuel testing loop. (2) Demonstrate the feasibility of collapsed clad fuel elements in a reactor environment, cooled by supercritical water. (3) Evaluate the design of the fuel elements by post-irradiation examination. (4) Evaluate loop performance by analyzing operating data. Two fuel assemblies manufactured by different methods (pellets and vibratory compaction) were to be tested. Fuel rods containing pellets were clad with Incoloy 800, while those which are vibratory compacted and swaged were clad with 16 Cr–20 Ni stainless steel. An existing loop design and large number of loop components previously purchased by Westinghouse have been turned over to the AEC under the terms of the contract. The design of the loop is complete and the remainder of the components have been purchased under the contract. Fuel assembly and pressure tube designs have been completed. Two pressure tubes and the first fuel assembly have been fabricated. The program was suspended on April 15, 1965 and the contract was terminated on November 3, 1965. Author (NSA)

N68-37822# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

RADIAL VANE STEAM SEPARATOR DEVELOPMENT, PHASE 2 Quarterly Report, Jan.–Mar. 1968

R. H. Moen and J. E. Gifford Apr. 1968 17 p

(Contract AT(04-3)-189)

(GEAP-5636; EURAEC-2046) CFSTI: HC $3.00/MF $0.65

Progress is reported on the development of a radial vane steam separator. The model separator performed satisfactorily in wall cylinders which give a 1-inch or a 1/2-inch clearance gap between the upper vortex and the separator vanes. Thus, there was an increase in the probability that the large diameter separator, as requested for the KBR reactor, will perform satisfactorily with a small clearance gap. However, with the addition of core spray and feedwater sparger pipes to the system, carryover becomes excessive with the separator operating at KRB flows and water level. This problem appears to be solvable by extending the wall cylinder to a smaller diameter in the core spray pipe region and extending the cylinder to some point below the feedwater sparger pipe. Another test will be required to demonstrate the solution. Author (NSA)

N68-37858# Southern Nuclear Engineering, Inc., Dunedin, Fla.

INVESTIGATION OF THE USE OF AQUEOUS SOLUTIONS AS EMERGENCY COOLANTS Quarterly Report

C. Rogers Mc Cullough, Gilbert M. Brown, R. P. Hancock, W. A. Maxwell and S. E. Turner Jul. 1968 91 p 38 p refs

(Contract AT(40-1)-3749)

(SNE-40) CFSTI: HC $3.00/MF $0.65

The results of a literature search are presented for additive candidates and additive solution properties, screening tests to narrow the candidate list, and single rod-heated enclosure deluging and flooding tests. The screening tests are performed by submerging at 1600°F, 25000 Btu/(hr)(ft^2) Zircaloy clad resistance heater in a vertical tube filled with the boiling solution. The single rod-heated enclosure tests consist of a single, six-foot long, Zircaloy-clad resistance heater vertically mounted in a 1.5 in. pipe which is heated. The coolant is injected into the enclosure at the top for deluge, or injected at the bottom for flooding. NSA

N68-37866# General Electric Co., San Jose, Calif. Nuclear Fuels Dept.

ZIRCALOY CLAD URANIUM DIOXIDE FUEL ROD EVALUATION PROGRAM Quarterly Progress Report, Nov.–Jan. 1968

F. H. Megerth comp. Mar. 1968 39 p

(Contract AT(04-3)-189)

(GEAP-5598; QPR-1) CFSTI: HC $3.00/MF $0.65

Zircaloy-2 clad UO_2 fuel rods from the first shutdown of the Vallecitos Boiling Water Reactor (VBWR) were incorporated in a special assembly and inserted in the Dresden Reactor for additional irradiation to determine the earliest possible time for the fuel to achieve average burnup of at least 6×10^{20} fissions/cc (20,000 MWd/stU). Results of examinations of 10 of the 88 additionally irradiated rods are reported. NSA

N68-37878# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.

FLOW DISTRIBUTION MEASUREMENTS IN A 3-SCALE MODEL OF THE SEFOR FUEL BUNDLE

R. F. Williams, E. E. Polomik and C. E. Russell Apr. 1968 88 p 4 refs

(Contract AT(04-3)-540)

(GEAP-5184) CFSTI: HC $3.00/MF $0.65

Mass flow distribution in the SEFOR fuel bundle was determined by means of velocity measurements in a 3-scale model, using water to simulate the hydraulic parameters of the reactor. Velocity measurements were obtained by means of a radially transversing pitot tube mounted in one of the simulated fuel rods. This rod could be rotated to any angular position desired for a velocity transverse, and the pitot tube could be mounted at any one of four elevations. Data were obtained at each elevation to determine the effect of changes in rod pitch. The effects caused by rod tilt, unequal rod spacing, and changes in Reynolds' number were also investigated. Changes in rod pitch had the most significant effect on flow distribution. Reynolds' number had a negligible effect in the range tested (N_{Re} = 43900 to 66000). The measured and predicted data were used to choose the optimum rod pitch with respect to thermal bowing gradients in SEFOR. Author (NSA)

N68-37880# Argonne National Lab., Ill.

REACTIVITY INTEGRAL THEOREM FOR A CRITICAL REACTOR [TEOREMA OB INTEGRALE REAKTIVNOSTI KRITICHESKOGO REAKTORA]

E. A. Stumbur Jun. 1968 8 p 5 refs Transl. into ENGLISH of Gos. Kom. po Ispol'z. At. Energ. SSSR, Obninsk Rept. FEI-77

(ANL-TRANS-645) CFSTI: HC $3.00/MF $0.65

A theorem is proven which correlates the integral of reactivity coefficients (statistical weights) by the volume of a critical reactor with the property gradients of the medium or for a reactor which consists of homogeneous regions with the reactivity coefficients at the boundaries. The proof is given on the basis of a general kinetic equation with the energy dependence of all quantities. The only limitations of the theorem are the requirements of the convexity and homogeneity of the external boundary of the reactor. Author (NSA)

N68-37884# Oak Ridge National Lab., Tenn.

POTENTIAL METAL-WATER REACTIONS IN LIGHT-WATER-COOLED POWER REACTORS

Howard A. McLain Aug. 1968 201 p refs

(Contract W-7405-ENG-26)

(ORNL-NSIC-23) CFSTI: HC $3.00/MF $0.65

The available data regarding the role of chemical reactions in the unlikely event of a light-water power reactor accident were collated and reviewed. These reactions must be considered as only one of the many aspects of a reactor accident, and only by considering an integral model of the accident can they be assessed realistically. Compared with the situation regarding the definition

and mathematical simulation of the reactor accident, the basic kinetics of the chemical reactions are well understood. Contributions of the metal-water reaction to the consequences of a nuclear-excursion accident appear to be minor compared with the other aspects of these accidents. In a loss-of-coolant accident, prompt initiation of emergency core-cooling systems would limit the amount of metal-water reaction to a low value. However, possible fragmentation of fuel pins having chemically reacted cladding makes it difficult to interpret quantitatively the criterion that the cladding metal-water reaction is to be limited to negligible amounts. Without the use of emergency core-cooling systems, it appears that the amount of metal reacted prior to the melting of the reactor core would be between 25 and 50%. H_2 explosions are not usually considered credible, since H_2 produced by the metal-water reaction is assumed to be below its flammability limit or is assumed to burn upon entry into the containment vessel. Although there is much information to back up these assumptions, more work should be done regarding the detonation limits of H_2-air-steam mixtures and the possible pocketing of H_2 within containment vessels. Author (NSA)

N68-37887# Instituto de Asuntos Nucleares, Bogota (Colombia).
PRODUCTION OF RADIOISOTOPES IN THE REACTOR IAN-R1 [PRODUCCION DE RADIOISOTOPOS EN EL REACTOR IAN-R1]
E. A. Paez and S. J. Nassiff 1968 49 p refs In SPANISH
(IAN-Q-6)

A compilation is given of the best known methods for the production of radioisotopes and the adaptation of these methods to the conditions available at the IAN-R1 Reactor. In the discussions it is assumed that a flux of 10^{11} neutrons/cm^2 sec is available. Methods are given for ^{131}I, ^{24}Na, ^{198}Au, ^{14}C, ^{35}S, ^{32}P, and ^{137}Cs. The production of ^{131}I as a fission product is also discussed. NSA

N68-37888# Atomic Energy Commission Research Establishment, Riso (Denmark).
RECOMMENDATIONS FOR SAFEGUARDS INSPECTION OF UNIRRADIATED MTR FUEL ELEMENTS
H. Kunzendorf and L. Loevborg Mar. 1968 15 p 12 refs
(RISO-M-732; R-16-68)

On the basis of experiments with assemblies of MTR fuel elements of the type used in the Danish research reactor DR 2, a set of procedures, based on the use of a portable γ-spectrometer, for safeguards inspection of these and similar fuel elements are drawn up. It is estimated that the method will at least make it possible to detect the absence of an amount of the ^{235}U in the fuel element equal to the normal content in one fuel plate. Author (NSA)

N68-37889# Commissariat a l'Energie Atomic, Grenoble (France). Centre d Etudes Nucleaires.
NEUTRON DETECTION IN AN ATOMIC REACTOR CORE USING SEMICONDUCTORS [DETECTION DES NEUTRONS PAR SEMI-CONDUCTEUR DANS UN COEUR DE REACTEUR ATOMIQUE]
Francois Divous Jan. 1968 72 p 45 refs In FRENCH
(CEA-R-3304)

The principle of nuclear particle detection by semiconductor diodes is described. Fabrication of the semiconductor device used to estimate thermal neutron fluxes in the core of a swimming pool-type reactor is discussed. The useful volume (2.9 mm thickness) is in the light water moderator, between fission element plates. The results, principally obtained in the core of the Siloette reactor at the Centre d'Etudes Nucléaires de Grenoble at low power, are presented. Flux maps are included and comparison between converter products boron-10, lithium-6, and uranium-235 is made. Author (NSA)

N68-37904# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
INVESTIGATION OF RADIATION DAMAGE IN ZrO_2, ZrN, ZrC, AND UO_2, UN, UC THROUGH X-RAY DIFFRACTION [UNTERSUCHUNG VON STRAHLENSCHAEDEN IN ZrO_2, ZrN, ZrC, UND UO_2, UN, UC DURCH ROENTGENSTRAHLENBEUGUNG]
W. Dienst and D. Brucklacher Mar. 1968 25 p 21 p In GERMAN
(KFK-745; EUR-3711.d)

Powder samples of ZrO_2 (cubic stabilized), ZrN, ZrC, and UN, UC were irradiated in the Karlsruhe reactor FR-2 at temperatures below 150°C up to integrated fast neutron fluxes of 2.5×10^{19} n/cm^2 ($E > 100$ keV) or up to fission densities of 6.4×10^{18} fission/cm^2. The changes in the lattice constants caused by irradiation ($\Delta a \approx 1$ to 5×10^{-3}) and the X-ray reflection widths were measured with an X-ray counter goniometer for radioactive samples. The difference in the $\Delta a/a$ saturation pattern for the Zr compound can be brought into the relationship so that the resistance with respect to the formation of large interstitial lattice atom clusters increases in the transition from extensively ionic to covalent compounds. The results for UN, UC were compared with the literature data for UO_2. In all cases, after the initial saturation of the lattice constant increases, a transient decrease occurs followed by a later rise of the lattice constants leading to the highest attained fission density. In the first saturation of the lattice constant increase, a strong X-ray reflection broadening occurs which is probably due to the formation of large interstitial atom clusters. All radiation effects are sharply emphasized in the UN samples. These results suggest that the mobility of the point defects in the lattice of the uranium compounds decreases in the sequence $UO_2 \rightarrow UC \rightarrow UN$. Author (NSA)

N68-37907# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
EFFECT OF REACTOR IRRADIATION ON SANTOWAX OM AND WR
E. A. Mason, M. L. Lee, S. T. Brewer and W. N. Bley Jun. 1968 386 p refs
(Contract AT(38-1)-1968)
(MIT-334-94) CFSTI: HC$3.00/MF$0.65

Irradiations of the terphenyl mixtures, Santowax OM and WR, were made at temperatures ranging from 300° to 427°C. These potential coolants for nuclear reactors were irradiated while flowing through a stainless steel in-pile loop installed in a special fuel element. Steady state operating conditions were maintained by continually removing coolant samples from the loop and feeding processed coolant to the loop. The coolant samples were processed using a High Boiler (HB) distillation procedure to remove HB. The distilled terphenyls and Low and Intermediate Boilers (LIB) were returned to the loop along with fresh makeup. The dose rates to the terphenyl coolant due to fast neutrons and gamma-rays were measured using adiabatic calorimeters. Resonance and threshold foils were used as a check on the calorimetric measurements of the fast neutron fraction of the total dose rate. Three steady-state low temperature (300°C) irradiations of Santowax OM were made at different terphenyl concentrations to determine the apparent reaction order for radiolysis and the rate constants for degradation by radiolysis. Author (NSA)

N68-37923# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
REACTIVITY MEASURE OF CONTROL RODS BY THE ROD-DROP TECHNIQUE [MISURE DI REATTIVITA DI BARRE DI CONTROLLO COL METODO DEL ROD-DROP]
U. Farinelli and A. Musco 1968 31 p refs In ITALIAN; ENGLISH summary
(RT/FI(68)24) CFSTI: HC$3.00/MF$0.65

The rod-drop technique was applied in order to measure large negative reactivities. Measurement methods, experimental

performance and some results of measurements on the ROSPO reactor are described. The method is applied in order to evaluate interactions between control rods. Author

N68-37927*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF TURBULENT MIXING ON AVERAGE FUEL TEMPERATURES IN A GAS-CORE NUCLEAR ROCKET ENGINE
Albert F. Kascak and Annie J. Easley Washington Nov. 1968 28 p refs
(NASA-TN-D-4882) CFSTI: HC$3.00/MF$0.65 CSCL 21F

A heat transfer analysis was made for a coaxial flow nuclear rocket. The analysis considers one-dimensional radial transfer of heat, by both radiation and turbulent mixing from a centrally located fissioning gas to a coaxially flowing propellant. The results compare the effective thermal conductivities for radiation and turbulent mixing. Also included are typical radial-temperature profiles at various axial locations and average fuel temperatures showing the effect of neglecting turbulent mixing. Turbulent mixing had a large effect on local temperature in regions where the fuel density was smallest. Therefore, the effect of turbulent mixing on the average fuel temperature was small. Author

N68-37951# Martin Co., Baltimore, Md. Nuclear Div.
SNAP 19, PHASE 3. VOLUME 3: GENERATOR DEVELOPMENTAL ASPECTS Final Report
May 1968 87 p refs
(Contract AT(30-1)-3607)
(MND-3607-239-3, V. 3) CFSTI: HC$3.00/MF$0.65

The purpose of SNAP-19 III Program is described. Thermoelectric couple development, component selection criteria and the module criterion are described. A description of development of advanced techniques for fuel handling, outgassing and leak testing generators is presented. Heater element and heater block development, including problems encountered and method of resolution are discussed. The configuration of generators tested, preparation for the tests and the tests; results of pre-endurance and endurance tests; evaluation of thermoelectric components and conclusions drawn from endurance tests are reviewed. Design features that provide reliability, and tests that provided reliability data are covered. The performance of Viton A as generator seals is discussed. Hot junction temperature measurement system, the problems experienced during its development and the means of problem resolution are discussed. Methods used in making neutron and gamma measurements, and spectra from these measurements are presented. The method of capsule support, problems encountered with support design and means by which problems were corrected are described. Author (NSA)

N68-37972# Oak Ridge National Lab., Tenn.
OXIDATION OF BONDED COATED-PARTICLE FUEL COMPACTS BY STEAM
C. M. Blood, G. M. Hebert, and L. G. Overholser Jul. 1968 31 p refs
(Contract W-7405-ENG-26)
(ORNL-4269) CFSTI: HC$3.00/MF$0.65

Fuel compacts, consisting of bonded beds of pyrolytic-C coated fuel particles encased in graphite, were oxidized at 1000, 1100, and 1200°C using He-steam mixtures having partial pressures of steam of 20, 70, or 150 torr and a total pressure of 1 atm. Overall reaction rates and BET surface areas were determined at various burnoffs and the oxidized fuel compacts examined for possible damage to the graphite containers, bonding materials, or the pyrolytic C coatings on the fuel particles. Fuel compacts oxidized to burnoffs of 6 and 14 wt. % experienced no significant damage to the pyrolytic C coatings and only limited attack of graphite containers. A fuel compact oxidized to ≈50 wt % burnoff was severely damaged resulting, however, in failure of only 0.2% of the coatings. Graphite containers were found to be less effective in protecting the bonded bed against damage from oxidation at 1000°C than at higher temperatures. Author (NSA)

N68-37976# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
EVACUATION OF THE REACTIVITY OF FINITE DIMENSIONAL SAMPLES INTRODUCED IN A REACTOR [DETERMINAZIONE DELLA REATTIVITA PER CAMPIONI DI DIMENSIONI FINITE INTRODOTTI IN REATTORE]
F. Orestano and F. Pistella 1968 36 p refs In ITALIAN; ENGLISH summary
(RT/FI(68)23) CFSTI: HC$3.00/MF$0.65

The reactivity of nonmoderating samples introduced in RANA reactor for oscillation measurements of effective absorption cross sections is evaluated. The evaluation is made by a two dimensional calculation method in transport theory properly devised for the present problem, but also interesting for other more general situations. Author

N68-38006# Martin Co., Baltimore, Md. Nuclear Div.
SNAP 19, PHASE 3. VOLUME 1. POWER SUPPLY SYSTEM Final Report
May 1968 172 p
(Contract AT(30-1)-3607)
(MND-3607-239-1, V. 1) CFSTI: HC$3.00/MF$0.65

Modes of operation and system performance in orbit; single generators and their performance characteristics; data on the heat source; thermoelectric conversion modules, housing, instrumentation and wiring, thermal insulation; and generator subsystem, power conditioner unit and telemetry signal conditioner unit are described. The mechanical, electrical, and thermal interfaces between SNAP-19 and Nimbus B are discussed, along with nuclear radiation and its effect on the system. The generator subsystem, power conditioner unit, telemetry signal conditioner unit, and power supply system testing are discussed. Performance criteria are given. Prototype qualification and flight acceptance testing are defined and described. Mass properties and radiation measurements are reported. Criteria for parts selection and screening, and also methods of determining, identifying and handling parts critical to successful performance are described. Failure modes and effects, demonstrated reliability and reliability predictions are discussed. Safety philosophy and the technical approach to safety are covered. Descriptions of the ground support test console, power supply rack, portable monitor, capsule shipping casks, generator subsystem handling, shipping and storage equipment, technical manual preparation and verification, and generator subsystem transportation are given. Design of generator subsystem from transmissibility, thermal conductance, magnetic moments and spacecraft shroud cooling standpoints is discussed in addition to testing of the power supply system with the spacecraft and a description of launch site operations. Author (NSA)

N68-38139# Brookhaven National Lab., Upton, N. Y.
PLUTONIUM DIOXIDE-URANIUM DIOXIDE-SODIUM AEROSOLS PRODUCED BY VAPORIZATION OF FAST REACTOR CORE MATERIALS
F. L. Horn and A. W. Castleman, Jr. [1967] 19 p refs Presented at the Symp. on Operating and Developmental Experience in the Treat. of Airborne Radioactive Wastes, New York, 26–30 Aug. 1968
(BNL-12757)

To determine the effect of a reactor accident on the leakage rate from the reactor containment, experiments were conducted to assess the time-dependent behavior of the PuO_2–UO_2–Na aerosol in relation to coagulation, settling, wall plating, particle size distribution, and particle density. The results show: (1) The vapor of both PuO_2 and UO_2 condenses into cubic crystals that form into long twisting chains characteristic of metal oxides. (2) The nature of PuO_2 vaporized into nitrogen, argon, and dry air are

essentially the same; in each case, the individual nucleated particles rapidly agglomerated into branched chains. (3) Although PuO_2 and UO_2 aerosol deposits appear to be similar, the UO_2 agglomerates are usually somewhat larger in size, resulting in more rapid settling of the pure UO_2 as well as mixed PuO_2–UO_2. Figures are included to depict mass concentration variations with time, and particle size distributions. An equation is proposed for making conservative estimates of the fractional decrease in aerosol concentration with time. M.G.J.

N68-38328# California Univ., Livermore. Lawrence Radiation Lab.
ADVANCED SPACE NUCLEAR POWER PROGRAM Quarterly Report, Jan.–Mar. 1968
Mar. 1968 48 p refs
(Contract W-7405-ENG-48)
(UCRL-50004-68-1, Pt. 1) CFSTI: HC $3.00/MF $0.65

Fabrication of Re–W tubing by chemical vapor deposition is described. Welding methods for Mo–Re–W alloys are tested. Fabrication of UN sintered powders is described. Physical properties of liquid lithium are presented. A description of the SPR-4 reference design is presented. NSA

N68-38443# Oak Ridge National Lab., Tenn.
FABCOST 9: A COMPUTER CODE FOR ESTIMATING FABRICATION COSTS FOR ROD-BUNDLE FUEL ELEMENTS
A. L. Lotts, F. J. Homan, and T. N. Washburn Aug. 1968 135 p refs
(Contract W-7405-ENG-26)
(ORNL-4287) CFSTI: HC $3.00/MF $0.65

FABCOST 9 was developed to achieve a quick, systematic estimation of fabrication costs with a reasonable degree of accuracy. This code is applicable to any fuel element consisting of an assembly of fuel rods. Both a general outline and specific details of the fabrication cost analysis are presented. Fabrication costs include the capital cost of the fabrication plant and equipment, the cost of operating the plant, and the cost of fuel element hardware. It is assumed that U or UO_2 is the starting material; therefore, the cost of conversion to UC for fuel elements is included in the fabrication costs. The code follows the fabrication flowsheet for the fuel element being studied. It calculates process throughputs, based on the design parameters of the fuel element. The throughputs form the basis of capital costs of fabrication equipment and daily manpower requirements for each process. The capital and operating costs are summed over all the processes required by the flowsheet and factors corresponding to the design parameters of the fabrication plant are applied to the sums. Hardware costs are calculated on the basis of the cladding and structural material specified, the quantity, and the dimensions. Author (NSA)

N68-38444# Idaho Nuclear Corp., Idaho Falls.
BURNUP DETERMINATION OF NUCLEAR FUELS Project Report, 1 Jul.–30 Sep. 1967
Frederick L. Lisman, ed., William J. Maeck, ed., and James E. Rein, ed. Jul. 1968 50 p refs
(Contract AT(10-1)-1230)
(IN-1189) CFSTI: HC $3.00/MF $0.65

The thermal fission yields of Ba, Ce, Cs, Kr, Nd, Rb, Sr, Xe, and Zr isotopes from ^{239}Pu were determined using isotope dilution mass spectrometry. The effective capture-to-fission ratio for ^{239}Pu was also measured. NSA

N68-38468# Idaho Nuclear Corp., Idaho Falls.
BURNUP DETERMINATION OF NUCLEAR FUELS Project Report, 1 Oct.–31 Dec. 1967
Frederick L. Lisman, ed., William J. Maeck, ed., and James E. Rein, ed. Jul. 1968 18 p refs
(Contract AT(10-1)-1230)
(IN-1207) CFSTI: HC $3.00/MF $0.65

In a program to develop methods for the accurate determination of the burnup of nuclear fuels, the fast-fission yields of many stable and long-lived fission products from ^{235}U in an EBR-I MARK III fuel rod were measured. The main measurement technique was isotope dilution mass spectrometry. Fast-fission yields relative to ^{148}Nd were determined for: ^{83}Kr, ^{84}Kr, ^{85}Kr, ^{85}Rb, ^{86}Kr, ^{87}Rb, ^{88}Sr, ^{90}Sr, ^{99}Tc, ^{101}Ru, ^{103}Ru, ^{104}Ru, ^{111}Cd, ^{112}Cd, ^{113}Cd, ^{114}Cd, ^{116}Cd, ^{131}Xe, ^{132}Xe, ^{133}Cs, ^{134}Xe, ^{135}Cs, ^{136}Xe, ^{137}Cs, ^{138}Ba, ^{140}Ce, ^{142}Ce, ^{143}Nd, ^{144}Nd, ^{144}Ce, ^{145}Nd, ^{146}Nd, ^{148}Nd, ^{149}Sm, ^{150}Nd, ^{151}Sm, ^{152}Sm, and ^{154}Sm. NSA

N68-38497# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR PHYSICS DEPARTMENT TECHNICAL ACTIVITIES Quarterly Report, Jan.–Mar. 1968
F. G. Dawson and P. L. Hofmann 22 Jul. 1968 104 p refs
(BNWL-775) CFSTI: HC $3.00/MF $0.65

This report contains information on the following: (1) thorium oxide and uranium oxide fuel management and reactivity measurements for the Physical Constant Test Reactor; (2) fission calculations, lattice analyses, and criticality studies for uranium oxide and plutonium oxide; (3) core calculations, flux measurements, and gas release in the Fast Test Reactor; (4) criticality studies on slab-shaped plutonium nitrate and polystyrene-plutonium oxide lattices; (5) argon and nitrogen gas coolant analyses for the Fast Flux Test Facility; (6) shielding properties of liquid sodium; and (7) computer programs related to reactor operations. K.W.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-37422 Case Western Reserve Univ., Cleveland, Ohio.
THE INFRARED SPECTRUM OF METHANETHIOL AND METHANETHIOL (SD) IN THE GAS, LIQUID, AND SOLID PHASES
Ingo Werner May (Ph.D. Thesis) 1967 118 p 1 ref
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-3318

The spectral investigation of CH_3SH and CH_3SD resulted in new frequency data for the gas, liquid and solid, and normal mode assignments were revised for the symmetric and antisymmetric C–H stretching modes, the antisymmetric methyl deformations, and the methyl wagging modes. The barrier to the hindered rotation based on the Raman observed frequency of the liquid at 183 cm^{-1} was determined to be about 410 cm^{-1}. The main feature of the solid state spectra, the Davydov splittings, was considered. Four peaks were observed for the ν_3 (A') S–H(D) stretching mode and the ν_7 (A') S–H(D) bending mode, while only two peaks could be found for the A'' modes. Several Debye–Scherer powder patterns were obtained at liquid nitrogen temperatures and three consistent sets of unit cell dimensions were calculated through the usual powder pattern analysis. An attempt was made to calculate the Davydov splittings of the C–S stretching mode and the methyl wag, using the dipole–dipole interaction model. Significant spectral changes were found to accompany the phase transition that occurs at about thirteen degrees below the freezing point. Dissert. Abstr.

N68-37428 New Mexico State Univ., University Park.
TOPICS IN LIGHT SCATTERING
Jon Erik Sollid (Ph.D. Thesis) 1967 140 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-267

Using Dirac's noncovariant theory of radiation, light scattering from ionic crystals is treated, obtaining theoretically for the first time the experimentally observed wave length dependence and the correct form for the scattering scalar. In so doing, a mild or modified form of the Wigner–Seitz zero-k approximation is evoked in describing the wave functions of the electrons in the crystal. This treatment clarifies the role of the generally neglected charge term in the scattering scalar which arises through the A^2 term in the Hamiltonian. Radiation scattering from free electrons and monostomic gases is also treated. Relativistic effects due to rapidly moving electrons interacting with low energy photons are assessed. A theory for the coherent and incoherent light scattering from a thermonuclear plasma using techniques of Salpeter and the classical electrodynamics is developed. Dissert. Abstr.

N68-37465 Northwestern Univ., Evanston, Ill.
NON-AXIALLY SYMMETRICAL BOUNDARY VALUE PROBLEMS IN ELASTICITY
Whai-sang Fu (Ph.D. Thesis) 1967 83 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-3182

Two related classes of non-axially symmetric boundary value problems of the three-dimensional linear theory of elasticity, known as punch and crack problems are investigated. Basic solutions to equations governing the steady-state thermoelastic fields, in the absence of body forces and heat sources, are collected and expressed in a variety of forms in terms of harmonic functions. Thermoelastic stress distributions due to the combined loading of rigid, non-axially symmetric, circular puncher and an arbitrary steady-state temperature of heat flux are considered for a thick elastic plate, and the stress distributions in an unbounded elastic medium are sought when in-plane loading is prescribed over two coplanar circular regions. Dissert. Abstr.

N68-37556 Tulane Univ., New Orleans, La.
INVESTIGATION AND DESIGN OF A FLUID COUPLED ACOUSTIC TRANDUCER SYSTEM FOR THE DETECTION OF ACOUSTIC EMISSION
Milton Morris Bolles (Ph.D. Thesis) 1967 79 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17902

A fluid coupled transducer system was designed and evaluated in an attempt to increase the signal to noise ratio for a typical acoustic emission pulse. The system consisted of a fluid filled, elliptic cylindrical container with the longitudinal axis of the specimen arranged collinearly with one of the focal axes of the container. A cylindrical piezoelectric crystal was located in a similar manner along the other focal axis. The container served as a reflector and was designed to focus the acoustic energy emitted by the specimen onto the crystal. For the purpose of comparison, an additional piezoelectric crystal was affixed to the end of the specimen. An analysis of the results showed that the signal to noise ratio was generally higher for the fluid coupled transducer system. The analysis also indicated a correlation between the direct coupled and fluid coupled systems of approximately 60–75% relative to the least active of the systems. Dissert. Abstr.

N68-37658 Tennessee Univ., Knoxville.
A STUDY OF THE THREE-BODY PROBLEM IN QUANTUM MECHANICS
James Holley Marable (Ph.D. Thesis) 1967 141 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-3754

The usual classification of the coordinates of N-body systems as translational, rotational, or internal has been further refined. In particular, the internal coordinates have been divided into two classes: (1) three-size coordinates and (2) 3N-9 angular coordinates which specify elements of an orthogonal matrix. By means of these latter coordinates, an analogy may be made to the motion of a three-dimensional rigid body in an N-1 dimensional space. The form and structure of the metric tensor corresponding to the above classification is calculated. The formalism leads to a natural system of coordinates which is developed explicitly for the three- and four-body systems. Harmonic functions for the three-body system are investigated using the coordinates developed. The number of multiplets associated with a given orbital angular momentum quantum number is calculated. Dissert. Abstr.

N68-37713*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y. Power Conversion Dept.
MEASUREMENT OF ELECTRIC FIELDS IN THE IONOSPHERE, VOLUME 2 Final Report, Aug. 1966–Sep. 1967
Gerald Levy, Herbert Jacobs and Edgar Bendor Sep. 1967 124 p refs
(Contract NAS8-20663)
(NASA-CR-98043; PCD-TR-67-9A; FHR-3287-2) CFSTI: HC $3.00 CSCL 20C

An experimental laboratory model of an electric field meter was developed using electron beam deflection techniques. Designed for operation in the vicinity of a spacecraft in the ionosphere, the meter uses a weak beam of less than one microampere so that the environment and field are not disturbed. The meter has a dynamic range from 10 to 1000 v/meter with an accuracy of ± 1 mv/meter at 10 mv/meter and ± 1% above 100 mv/meter. Instrument design and performance are detailed, including laboratory testing; and mission categories, concepts, and constraints are considered. Attention is also given to the interaction of bodies with the ionosphere, including the undisturbed ionosphere and the surface potential, the near field of region B, and the plasma sheath. M.W.R.

N68-37792*# Israel Program for Scientific Translations, Ltd., Jerusalem.
ANALYTICAL MECHANICS. STABILITY OF MOTION. CELESTIAL BALLISTICS [ANALITICHESKAYA MEKHANIKA, USTOICHIVOST' DVIZHENIYA, NEBESNAYA BALLISTIKA]
A. I. Lur'e, ed. et al 1968 262 p 454 refs Transl. into ENGLISH of the "Proc. of the 2nd All-Union Conf. on Theoret. and Appl. Mech., Pt. 1" Moscow, Izd. Nauka, 1965 Conf. held at Moscow, 29 Jan.–5 Feb. 1964 Sponsored jointly by NASA and NSF
(NASA-TT-F-503; TT-68-50305) CFSTI: HC $3.00/MF $0.65 CSCL 20

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N68-37793*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DEVELOPMENT OF THE THEORY OF CANONICAL EQUATIONS OF ANALYTICAL MECHANICS

I. S. Arzhanykh *In its* Anal. Mech. Stability of Motion, Celestial Ballistics 1968 p 1–10 7 refs (See N68-37792 24-23)

As Hamiltonian canonical systems have relevance for integration problems, certain theorems of dynamics were extended to arbitrary systems of ordinary differential equations. Consideration is given to the methods of Liouville and Lie–Koenigs for reducing such systems to a Hamiltonian system. It is pointed out that the disadvantage of the Liouville method is that it introduces many redundant unknowns. Although the Lie–Koenigs method avoids this, a knowledge of the integral invariant is required. Integration theorems for systems are extended to the systems of equations without reducing them to any specific canonical form, and the relevance of the Poisson theorem for Hamiltonian canonical equations is shown. Some universal canonical structure is proposed for the system by generalizing the Hamiltonian canonical structure. These include canonical equations of rank higher than zero, invariance under contact transformations, and relation of the integration problem to the theory of Lie groups. M.G.J.

N68-37794*# Israel Program for Scientific Translations, Ltd., Jerusalem

STABILITY AND INSTABILITY OF DYNAMIC SYSTEMS WITH MANY DEGREES OF FREEDOM

V. I. Arnol'd *In its* Anal. Mech. Stability of Motion, Celestial Ballistics 1968 p 11–14 (See N68-37792 24-23)

The correspondence between exact and approximate solutions of the equations of dynamics over an infinite time interval is considered. It turns out that the stability of systems with one or two degrees of freedom may usually be ascertained on the basis of the first approximation. On the other hand, a system with $s \geq 3$ degrees of freedom may be stable in all the approximations of perturbation theory, and unstable in reality. Author

N68-37795*# Israel Program for Scientific Translations, Ltd., Jerusalem.

APPLICATION OF STABILITY THEORY TO STATIC AND DYNAMIC STABILITY PROBLEMS OF POWER SYSTEMS

G. V. Aronovich et al *In its* Anal. Mech. Stability of Motion, Celestial Ballistics 1968 p 15–26 20 refs (See N68-37792 24-23)

Consideration is given to the problem of determining the stability or instability of a power system for given values of its parameters under a given perturbation, or in determining values of the parameter which ensure stability without defining the probabilities of stability violation. It is pointed out that there is no essential difference between stability violations and other failures, and that these violations should be taken into account in estimating the total probability of continuous electric supply along with failures in stationary units, breaks in electric transmission lines, etc. The restrictions governing the control functions of the system's operating conditions are formulated as inequalities. Two principal approaches to power system stability are assessed: (1) rigorous (exact or approximate) solutions for simple power systems, and (2) intuitive engineering solutions for multi-machine systems, which consist in reducing them to simpler ones. The application of integrodifferential equations to the complex power system problem is discussed. M.G.J.

N68-37796*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ABSOLUTE STABILITY OF NONLINEAR CONTROL SYSTEMS

F. R. Gantmakher et al *In its* Anal. Mech. Stability of Motion, Celestial Ballistics 1968 p 27–66 53 refs (See N68-37792 24-23)

A differential equation is formulated for describing control systems containing one or several nonlinear units subjected to external forces, and a literature survey is presented on methods of constructing Liapunov functions for solving these problems. It is concluded that many theorems of the Liapunov type exist which reduce some specific problem in the theory of differential equations to the existence problem for a function possessing some special properties. The problem of solving special matrix inequality is examined in relation to the case where existence conditions are sought for the required function in some previously delineated class of functions. Several examples of these algebraic problems are given, including vector-matrix notations, Lure method, special matrix inequalities and their solution, Popov's frequency condition, absolute stability with given damping index, systems with discontinuous nonlinearities and hysteresis nonlinearities, differential nonlinearities for strengthening Popov's frequency condition, systems with external action, dissipative systems, existence of periodic motions, absolutely stable periodic and almost-periodic limit motions, and nonlinear sampled data systems. M.G.J.

N68-37797*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CONTINUUM PROBLEMS FOR ANALYTICAL MECHANICS

N. A. Kil'chevskii *In its* Anal. Mech. Stability of Motion, Celestial Ballistics 1968 p 67–81 42 refs (See N68-37792 24-23)

A literature survey was conducted to analyze research in analytical mechanics pertaining to the field which unifies the mechanics of discrete and continuous systems. It was found: (1) The greatest progress is bound up with geometrical interpretations of the general laws of motion of material systems, and that basically these interpretations are related to new methods for solving complicated problems of mechanics. (2) Approximate methods for solving problems of continuum mechanics lead to the formulation of new problems of the mechanics of systems with many degrees of freedom. Several examples are given to illustrate this point. In considering the two important problems of analytical continuum mechanics, attention is focused on the relation between the kinetic-stress functions, and a variational principle analogous to the Ostrogradskii–Hamilton principle. Also discussed is the relation between this principle and the basic law of continuum mechanics, and the general problem of integrating the equations of continuum mechanics using extensions of the theorems of classical analytical mechanics. M.G.J.

N68-37798*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PROBLEMS OF CONTROLLABILITY, OBSERVABILITY, AND STABILIZABILITY OF DYNAMIC SYSTEMS

N. N. Krasovskii *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 83–100 14 refs (See N68-37792 24-23)

Results are presented on the general regularities which have been established by well-defined methods for investigating three problems pertaining to the theory of controllable dynamic systems and the theory of optimal processes. The problems are (1) the control problem (CP) of calculating the forces which transfer the controlled object from a given state to another; (2) the observation problem (OP) of the operation which determines the unknown coordinates of the object on the basis of observable quantities; and (3) the stabilization problem (SP) of creating a regulating action which ensures stable realization of a given motion on the basis of accessible information. The CP and OP problems are considered as problems of constructing linear operators, satisfying given conditions, on the elements of some functional space. Using this approach the problems can be evaluated from the general standpoint of functional analysis, and the extension theorem for linear operators can be used in its specific forms. The SP problem is approached via the problem of synthesis of optimal systems, in particular the problem of analytical regulator design. M.G.J.

N68-37799*# Israel Program for Scientific Translations, Ltd., Jerusalem.

OPTIMAL CONTROL AND STABILITY

A. M. Letov *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 101–123 104 refs (See N68-37792 24-23)

The relation established between the optimality problem and Liapunov functions is discussed in the context of the quantitative aspect which the Liapunov stability theory has assumed. Attention is focused on the functional with respect to which the control system is optimized. Equations for brachistochronic motions are derived, with brachistochronic motion considered as Liapunov unperturbed motion. The basic problem of the theory of optimal control is formulated. Methods of solving the synthesis problems are discussed in terms of variational calculus and the maximum principle, and the Liapunov–Bellman method. The inversion problem is also formulated, and two approaches to the problem are described. M.G.J.

N68-37800*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DEVELOPMENT OF THE METHOD OF LYAPUNOV FUNCTIONS IN STABILITY THEORY

V. M. Matrosov *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 124–140 64 refs (See N68-37792 24-23)

Liapunov's second method is extended by simultaneous employment of several functions V, and of higher order derivatives of V, in the criteria for stability of motion. When this is done, the demands imposed on each function V are less stringent than those figuring in the classical Liapunov theorem or in its generalization, which involve single function V and its first derivative. This facilitates the search for the required functions V and makes the method more flexible. Author

N68-37801*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SOME PROBLEMS IN DYNAMIC STABILITY ANALYSIS OF MECHANICAL SYSTEMS WITH DEFORMABLE ELEMENTS

G. N. Mikishev et al *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 141–145 (See N68-37792 24-23)

An overview is presented on the theoretical and experimental methods and the physical models used to solve stability problems. Consideration is given to a solid body containing a cavity partially filled with liquid in a state of unperturbed motion; it is assumed that the field of mass forces of this motion has a potential. Motion stability is studied for a given system of external forces, assuming that the generalized coordinates and velocities characterizing the motion are small. It is also assumed that the liquid is of low viscosity, in the sense that the Reynolds number characterizing its perturbed motion is large; the usual premises of the theory of small wave motions and the linear theory of elasticity are adopted. To study both stationary and nonstationary perturbations of the motion in a finite time interval, equations of perturbed motion are represented in a definite form. Emphasis is placed on solving such problems by using analog devices, in which the mechanical system is represented by a physically similar model and the known external forces by special force generators. Summary data are presented on investigations into the dynamics of liquid-filled rigid bodies, and liquid-filled elastic bodies. M.G.J.

N68-37802*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EQUATIONS OF MOTION AND THE ROLE OF SMALL PARAMETERS IN THE DYNAMICS OF NONHOLONOMIC SYSTEMS

Yu. I. Neimark et al *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 146–156 28 refs (See N68-37792 24-23)

Several methods of deriving equations of motion for nonholonomic systems are reviewed, starting with the Chaplygin solution. The influence of small parameters on the dynamics of nonholonomic systems is examined, and several examples are given to clarify the problem of idealization involved in the neglect of small physical parameters when constructing a mathematical model of a nonholonomic system. A common approach is used, based on the division of the phase space into subspaces of slow and rapid motions. The cases considered pertain to a system with a nonlinear nonholonomic constraint; the influence of the usually neglected area of contact of a sphere with a plane on the dynamics of a sphere rolling along a rough plane; and the theory of differential equations in which the leading coefficient is a small parameter which contributes to the solution of a problem concerning the realization of a nonholonomic constraint. M.G.J.

N68-37803*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ANALYTICAL DYNAMICS AND OPTIMUM TRANSFER

V. S. Novoselov *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 157–169 14 refs (See N68-37792 24-23)

Equations of motion are derived for stationary conditions; the system is a canonical one with Hamiltonian H, momenta λ_i, and coordinates χ_i. This system differs from a mechanical canonical system in the linear dependence of H on the λ_i and the occurrence of additional variables. For an optimal trajectory, the Weierstrass–Erdmann conditions are obtained for the continuity of λ_i and H along the whole trajectory. To obtain necessary and sufficient extremum conditions, the criterion functional variation is integrated along the trajectory tubes. The Hamilton–Jacobi method is applied to solving the canonical system where the optimal trajectory and the undertermined factors satisfy canonical equations with Hamiltonian and controls considered as explicit functions of time. To provide sufficient equations for determining all the unknown quantities for a preassigned number of pulses, formulas are derived on the continuity of the undetermined multipliers, boundary conditions, conditions for the velocity increments for each propulsion period, and transversality conditions. Techniques for solving optimal impulsive transfer problems are discussed. M.G.J.

N68-37804*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE STABILITY MOTION OF SOLID BODIES WITH LIQUID-FILLED CAVITIES

V. V. Rumyantsev *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 170–188 26 refs (See N68-37792 24-23)

Nonlinear methods connected mainly with the development of Liapunov's ideas are reviewed, and their applicability to investigating motion stability of solid bodies with liquid-filled cavities is indicated. Attention is focused on the theory of equilibrium of

a rotating liquid, which is related to the stability of the form of the liquid; in this case the stability problem is reduced to minimizing a functional. Equations are derived for the simplest cases of irrotational motion, and homogeneous rotational motion of the liquid. A system of ordinary and partial differential equations, with appropriate initial and boundary conditions, is used to formulate the equations of motion for a liquid-filled solid body. Stability problems in relation to some variables are also formulated for solution. In considering the stability of steady-state motions, it is assumed that the motions of both the body and the liquid are continuous, so that the coordinates of each particle of the liquid are continuous functions of their initial values and time. The stability theorem is postulated, and proof of the corollaries is given. A method of solving the minimum problem is described. M.G.J.

N68-37805*# Israel Program for Scientific Translations, Ltd., Jerusalem.
STABILITY OF SYSTEMS WITH DELAY
S. N. Shimanov *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 189–200 23 refs (See N68-37792 24-23)

A literature review is presented on the stability of motion of systems described by differential equations with aftereffect or time delay. Discussion is centered around generalizations of the well-known classical theory of Liapunov stability for systems described by ordinary differential equations. To this category belong investigations by means of functionals, the general approach to the analysis of delay equations in function spaces, stability in the first approximation, the theory of the critical cases, and stability theory of linear and nonlinear periodic systems. Reference is made to published work of Soviet and non-Soviet authors, and to some new results of a general character in stability theory of periodic systems. Author

N68-37806*# Israel Program for Scientific Translations, Ltd., Jerusalem.
OPTIMIZATION PROBLEMS IN THE MECHANICS OF LOW-THRUST SPACE FLIGHT
G. L. Grodzovskii et al *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 201–221 45 refs (See N68-37792 24-23)

For solving the optimization problem, optimal relations between the weight components of the vehicle and optimal control of the propulsion system are selected and the set of optimal flight trajectories is determined. To describe the behavior of the vehicle, a complete system of equations is derived, consisting of the vector equation of motion, the weight relations, and the control characteristic of the engine. Two basic variational formulations for determining the trajectory are discussed. These procedures are applied to optimization problems for solar sail flights, and power-limited flights. M.G.J.

N68-37807*# Israel Program for Scientific Translations, Ltd., Jerusalem.
GRAVITY ATTITUDE STABILIZATION OF SATELLITES
V. A. Sarychev *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 222–232 14 refs (See N68-37792 24-23)

General principles on the attitude stabilization of artificial satellites are stated with respect to the trihedron formed by the radius-vector, the transversal, and the binormal to the orbit, called the orbital coordinate system. An overview is presented on the various schemes proposed to solve the design problems. These include (1) a stabilizer attached to the satellite by means of a three-stage suspension for stabilization and damping; (2) a gravity stabilization system with a single degree of freedom suspension; (3) a stabilizer consisting of three mutually perpendicular tubes of different lengths; (4) a hermetic viscous damper; and (5) hysteresis damping. The dynamics of gravity attitude stabilization systems is discussed in relation to the derivation and analysis of conditions for stability of the equilibrium position; rapidity of damping of natural oscillations; influence of drag; eccentricity oscillations; and errors. Experimental test data on the Transit satellites are given to illustrate the practical aspects of the system. M.G.J.

N68-37808*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME PROBLEMS OF ASTRODYNAMICS
G. N. Duboshin et al *In its* Anal. Mech. Stability of Motion. Celestial Ballistics 1968 p 233–238 (See N68-37792 24-23)

Orbit design is discussed in relation to solving basic flight problems; this involves describing all feasible trajectories, determining the initial conditions necessary for realizing any specific trajectory, and determining the kinematic and dynamic characteristics of the orbits. The need for economy in power consumption for launching and injection into orbit is discussed, along with the precision necessary in the selected nominal orbit and the choice of the correction method. It is pointed out that the computation algorithm for determining orbit parameters should be highly economical, require few iterations, be highly reliable and trouble-free, and guarantee convergence if the initial approximation is chosen poorly. An overview is included on methods of studying the rotational or librational motions of an unguided space vehicle about its center of mass. M.G.J.

N68-37893# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 4, NO. 9
Sep. 1968 103 p refs
CFSTI: HC $3.00/MF $0.65

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1. OPEN MILLIMETER-BAND RESONATORS S. G. Hibben p 1–30 refs (See N68-37894 24-16)

2. GAMMA-RADIATION OF THE MOON AND COMPOSITION OF THE LUNAR ROCKS FROM MEASUREMENTS BY LUNA-10 I. Velinov p 31–38 refs (See N68-37895 24-30)

3. BINARY AND TERNARY GALLIUM AND INDIUM CHALCOGENIDE SYSTEMS. PART 3: TERNARY SYSTEMS WITH A 1, 2, 3, or 4 GROUP ELEMENT J. Kourilo p 39–52 refs (See N68-37896 24-26)

N68-37905# Deutsche Versuchsanstalt fuer Luft-und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
DESCRIPTION OF A DIGITAL COMPUTING PROGRAMME FOR THE DETERMINATION OF TROPOSPHERIC AND IONOSPHERIC DOPPLER FREQUENCY ERRORS [BESCHREIBUNG EINES DIGITALEN RECHENPROGRAMMS ZUR ERMITTLUNG DES TROPOSPHAERISCHEN UND IONOSPHAERISCHEN DOPPLERFEHLERS]
D. Giesner and P. Edenhofer Jul. 1968 51 p 7 refs In GERMAN; ENGLISH summary
(DLR-Mitt.-68-15) CFSTI: HC $3.00/MF $0.65

Assuming the principles of geometrical optics, a formula is derived to calculate the doppler shift of a monochromatic wave radiating from a movable transmitter in the presence of an inhomogeneous, isotropic medium. This formula is specialized for the case of a satellite in elliptic orbit around a spherical earth whose atmosphere is inhomogeneous only in the radial direction. For the bearing error which arises in the doppler equation an approximated formula is derived. A computing program is described which determines the position of any satellite as a function of time, concurrently with its doppler frequency with and without atmospheric influence. It is assumed that an orbital element formulation for the satellite exists and that the model profiles of tropospheric and ionospheric made profiles can be introduced. Author

N68-37957# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.

MASS SELECTOR FOR ION BEAM EXPERIMENTS

Lowell P. Theard Jun. 1968 45 p refs *Its* Res. Commun. 68 (Douglas-Paper-5047; AD-674748)

A mass selector which efficiently produces mass filtered beams of both primary and secondary ions in the medium current ranges is described. Currents up to 0.000001 A for the mass filtered beam can be obtained with beam energies of 3-5 KeV. Ions are produced in a hot-cathode gas discharge ion source of relatively simple construction and are extracted as a parallel beam. Mass analysis is accomplished over a short path length with a compact, high-current, sector-field electromagnet which is entirely contained within the analyzer chamber. An electrostatic quadrupole lens is used for optimum shaping of the incident ion beam for high transmission through the magnetic sector. A second quadrupole lens, used to restore parallelism to the mass filtered ion beam, is mounted beyond the image slit, which was made wide enough to pass the entire image focused beam. The instrument has no object slit, as the entire incident beam is brought to a crossover at the object position. Beam transmission through all elements in the analyzer chamber, including the two quadrupole lenses, the sector magnet, and the image slit, is approximately 50 percent. Oscillating beam scanners are used to measure the beam density profile and to monitor the mass spectrum. The resolving power for spatial separation is about 60. Secondary ions such as N4(+) and CH5(+) can be generated with intensities comparable to those of primary ions. Author (TAB)

N68-37971# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.

STUDY OF TRANVERSE WAVE INTERACTIONS Triannual Report no. 6, 1 Jan.–30 Apr. 1968

K. I. Talbot, D. H. Durney, and R. W. Grow Jul. 1968 26 p refs

(Contract DA-28-043-AMC-01279(E))

(ECOM-01279-10; Rept.-10; AD-674648)

The purpose of this project is to evaluate analytically and experimentally the interaction of waves in a wave guide with waves on a rotating electron beam. The methods of analysis include use of a general coupled-mode theory, a ballistic computer program, and an experimental evaluation. A three-dimensional model was photographed from a computer graphics display. The photographs show how the beam bunches. This model was constructed in order to visualize the bunching process better and to help in determining a suitable power saturation criterion. Author (TAB)

N68-38023# Royal Aircraft Establishment, Farnborough (England).

HOLOGRAPHY—THREE DIMENSIONAL IMAGES USING LASERS [HOLOGRAPHIE—RAUMLICTE BILDER DURCH LASERLICHT]

H. Kiemle Sep. 1968 15 p refs Transl. into ENGLISH from Kino-Tech. (Germany), v. 7, 1967 p 155–158

(RAE-LIB-TRANS-1316) CFSTI: HC $3.00/MF $0.65

Holography is a novel method of optical recording and representation based on the coherence properties of laser light and permitting truly three-dimensional representation of the objects or scenes recorded. After explaining the principle of holography, the author considers its potential uses in cinematography and TV. The resulting technical problems are discussed along with current attempts to find solutions for them. Author

N68-38029# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

QUENCHING OF LIGHT FLASHES IN THE LIQUID SCINTILLATORS BY A DECAYING ELECTRICAL FIELD

L. Ya. Zhil'tsova, E. M. Matveeva, and M. N. Medvedev 1968 8 p refs In RUSSIAN

(JINR-P13-3894)

The results of the experiments on the quenching of light flashes in the liquid scintillators with the help of a decaying electrical field have been given. Author (NSA)

N68-38044# Technische Hogeschool, Eindhoven (Netherlands).

WAVE PROPAGATION AND MULTIPLE SCATTERING IN A RANDOM CONTINUUM

David Alter de Wolf (Ph.D. Thesis) 1968 153 p refs

CFSTI: HC $3.00/MF $0.65

Consideration is given to the interaction of nearly transparent but randomly fluctuating media upon propagating electromagnetic (EM) signals. Emphasis is placed upon solutions of the scalar wave equation derived from Maxwell's equations for monochromatic waves propagating through a random continuum. The use of the scalar equation is justified, and an approximate integral equation is developed for media with small spatial variations per wavelength. Also examined are simple approximate solutions of the wave equations, such as geometrical optics and single scattering regimes, and their validity is assessed in terms of the basic parameters. A two-dimensional scattering representation is used. An approximate high frequency perturbation method (HFPM) is presented, which yields statistics of the electric field valid beyond the region of validity of expressions based on the WKB and Born approximations. Experimental verification of the HFPM results are compared with other approaches. Modifications are proposed for the case of spherical wave propagation, and the backscatter cross section from a wide layer of not-too-weak dielectric irregularities are computed and evaluated. Author

N68-38181# ARO, Inc., Arnold Air Force Station, Tenn.

MEASUREMENTS OF CONDENSATION AND EVAPORATION OF CARBON DIOXIDE, NITROGEN AND ARGON AT CRYOGENIC TEMPERATURES USING A MOLECULAR BEAM Interim Report, Oct. 1966–Jul. 1967

J. H. Heald, Jr. and R. F. Brown Arnold Eng. Devel. Center Sep. 1968 76 p refs

(Contract F40600-69-C-0001)

(AEDC-TR-68-110; AD-674596) CFSTI: HC $3.00/MF $0.65

A high intensity, aerodynamic molecular beam generator combined with a sensitive modulated beam detector was used in the study of the condensation and evaporation processes of carbon dioxide, nitrogen, and argon (CO_2, N_2, and Ar) on cryogenically cooled surfaces. Molecular beams were impinged on a polished copper target at surface temperatures between 20 and 300K. The results of these experiments have shown that: (1) Room temperature molecular beams of CO_2, N_2, and Ar scattered from a copper surface at temperatures below 300K follow a cosine law scattering pattern. The scattering pattern remains unchanged after the initiation of condensation and also during the evaporation process. The scattering pattern was insensitive to angle of incidence for angles between 0 and 80 deg relative to the surface normal. (2) The initiation of condensation of CO_2, N_2, and Ar gases on cryogenically cooled surfaces follows a definite gas pressure and surface temperature relation which is predicted by the theoretical relations derived by Frenkel. (3) The measured CO_2 evaporation rate between 75 and 95K is in agreement with the extrapolation from published values at higher temperatures. (4) After initiation of condensation, the value of the capture coefficient is observed to approach a unity value. The high detector sensitivity allows measurements of capture coefficient up to 0.995. Author (TAB)

N68-38202# Aerospace Corp., El Segundo, Calif. Technical Operations.

RELATIVE MOTION IN THE VICINITY OF A BALLISTIC MISSILE

Leonard Rider Jul. 1968 24 p refs

(Contract F04701-68-C-0200)

(TR-0200(4510-01)-1; SAMSO-TR-68-332; AD-674619)

Approximate power series solutions to the linearized differential equations of motion are obtained in a rotating coordinate system with the origin moving on a ballistic trajectory of arbitrary eccentricity and through a central angle corresponding to the coast phase of a ballistic missile. The position propagation of injection velocity perturbations in the rotating system as determined by the first four terms of the series solutions is found to be sufficiently accurate to be utilized in preliminary design type analyses. Author (TAB)

N68-38241# Institute for Defense Analyses, Arlington, Va.
EXAMPLES OF GRAPHICAL SOLUTION OF SIX PROBLEMS IN ENGINEERING, MECHANICS, AND OPERATIONAL ANALYSIS
Michael Watter Jul. 1968 93 p
(Contract DAHC-15-67-C-0011; ARPA Order 19)
(P-405; AD-674369) CFSTI: HC$3.00/MF$0.65

The paper illustrates the use of graphical analyses by presenting the solution of six problems in the fields of operational analyses, mechanics, and engineering: The Jeep Problem, the Range of a Fleet of Aircraft, a Beam under Combined Compression and Transverse Load, the Problem of Cars Replacement, Determination of Ballistic Trajectory Parameters, and the Two-Magnetic-Reactor Problem. The purpose of this paper is to arouse an interest in a methodology which is further enhanced by the graphical display capability available in todays Computers with all its potential problem solving flexibility. The examples treated in this paper are not the stereotyped problems forming the usual subject of textbooks on graphical methods and, in that sense, should prove of greater interest to the reader. Author (TAB)

N68-38454# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
DETERMINATION OF THE MAGNETIC SURFACES IN THE STELLARATOR W IB BY THE USE OF A PULSED ELECTRON BEAM
E. Berkl, G. v. Gierke, and G. Grieger Jun. 1968 40 p refs
(IPP-2/69) CFSTI: HC$3.00/MF$0.65

Drift surfaces of a pulsed electron beam in the stellarator were studied to determine the extent and shape of existing magnetic surfaces, the exact values of the rotational transform, and whether or not shear exists in the magnetic field. The stellarator has the shape of a racetrack; its total length is 319 cm, and it has a vacuum tube diameter of 5.0 cm. The measurements allow the conclusion that magnetic surfaces exist with a degree of certainty of 700 : 1. The experimental value of the rotational transform was found to be 12% less than the calculated one. The shear is of a magnitude that could affect the stabilization of drift waves. The elliptical cross section of the magnetic surfaces requires some correction for the effective plasma volume and for the flux of plasma to a circular particle detector. K.W.

N68-38489# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
MAGNETIC FIELD OF LEVITATED SUPERCONDUCTING QUADRUPOLE W 6
F. Rau Apr. 1968 22 p refs
(IPP-2/67) CFSTI: HC$3.00/MF$0.65

Technical details are presented on the configuration and properties of the quadrupole. Discussions are given of the magnetic field which confines a low-β plasma in a flute-stable toroidal quadrupole and levitates two inner rings, and of the associated magnetic forces. The currents in the levitated rings and the configurations of the levitated rings and outer coils are described. N.E.N.

N68-38493# Stanford Univ., Calif. Dept. of Mathematics.
ON THE CAPACITY OF THE CIRCULAR DISC CONDENSER AT SMALL SEPARATION
Frank Leppington and Harold Levine Sep. 1968 48 p refs
(Contract Nonr-225(74))
(TR-13; AD-674518)

A pair of identical circular discs, held at equal and opposite potentials, forms a condenser whose capacity C depends on the ratio epsilon of separation against diameter. The determination of an asymptotic expansion for C when epsilon is small poses an axisymmetric boundary value problem for harmonic functions that has engaged the attention of numerous investigators over a long span of time. In the present work an integral equation of the first kind for the distribution of potential off the discs is derived and utilized to obtain an approximation for C when epsilon is small, reproducing the result of Kirchhoff and Hutson. Furthermore, an estimate of the error provides explicit details regarding the next term in the asymptotic expansion of C, which is of the order epsilon(log epsilon)squared. TAB

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-37426# Saha Inst. of Nuclear Physics, Calcutta (India). Theoretical Nuclear Physics Div.
A MODEL FOR π–π SCATTERING IN THE I=J=0 CHANNEL
H. Banerjee, B. Dutta-Roy and V. J. Menon 1967 13 p 26 refs
(SINP-TH-67-18) CFSTI: HC$3.00/MF$0.65

It is shown that the recent data on K_{e4} decay and the 3π decay modes of η and K^0_L admit of satisfactory interpretations in terms of a model for $\pi\pi$ scattering in the I=J=0 channel suggested by an analysis of the backward π–N dispersion relations. Author (NSA)

N68-37432 Duke Univ., Durham, N. C.
STRENGTH FUNCTIONS AND THE OPTICAL MODEL
Mundrathi Divadeenam (Ph.D. Thesis) 1967 156 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-3422

Neutron cross sections measurements on the separated isotopes of Mo, and remeasurements on natural Ru, Rh, La, Hf, Ta, W, Ir, Os, TlBi, Th, and U were made with improved techniques to minimize inscattering background when only small size samples are available for transmission measurements. Cross sections when averaged over hundreds of keV reveal both s- and p-wave giant resonance structure when plotted against A. Spherical non-local, and local potential model and collective potential model calculations are compared with averaged cross sections. The estimated results are compared with both spherical and collective potential model calculations. Dissert. Abstr.

N68-37435# Brookhaven National Lab., Upton, N. Y. Information Div.
MEASUREMENT OF THE RADIATIVE CAPTURE AND FISSION CROSS SECTION RATIOS FOR URANIUM-235 AND PLUTONIUM-239 IN THE RESONANCE NEUTRON ENERGY REGION

Yu. V. Ryabov, So Donssik, N. Chikov and N. Yaneva Jul. 1968 20 p 14 refs Transl. from At. Energ. (USSR), v. 24, 1968 p 351–362
(BNL-TR-219) CSFTI: HC$3.00/MF$0.65

Time-of-flight measurements of the neutron fission cross sections and the neutron capture-to-fission ratios of ^{239}Pu and ^{235}U were made over energy ranges of 5 eV to 23 keV and of 0.15 eV to 30 keV, respectively. Capture and fission resonance integrals were obtained from the data. NSA

N68-37450# Brookhaven National Lab., Upton, N. Y.
THE ATOMIC ELECTRONS AND NUCLEAR TRANSITION: SOME INTERRELATIONSHIPS
Morris L. Perlman Jun. 1968 10 p 8 refs Supported in part by AEC *Its* Lecture Ser. No. 72
(BNL-50100) CFSTI: HC$3.00/MF$0.65

Some of the ways in which the electrons of an atom and the nucleus of the same atom influence each other are discussed. Chemical effects of lifetimes or decay probabilities of electron-capture transitions, ionization of the atom associated with some radioactive decay modes, chemical effects on internal conversion, and extraction of information on nuclear structure from measurements of chemical effects are emphasized. NSA

N68-37463# Oak Ridge National Lab., Tenn.
CALCULATED Fe-56 NEUTRON SCATTERING AND GAMMA-RAY PRODUCTION CROSS SECTIONS FROM 1.0 TO 7.6 MeV
W. E. Kinney and F. G. Perey Aug. 1968 33 p 20 refs
(Contract W-7405-eng-26)
(ORNL-4249) CFSTI: HC$3.00/MF$0.65

Measurements of neutron elastic and inelastic scattering from ^{56}Fe, which were recently extended to incident neutron energies of 7.6 MeV, were analyzed theoretically. The shape-elastic cross sections, calculated with an optical model potential using fixed values of the parameters, added to the compound elastic contribution obtained from a Hauser–Feshbach calculation including width fluctuation corrections, agree reasonably well with the data from 4.0 to 7.6 MeV. Inelastic scattering cross sections from a Hauser–Feshbach calculation agree well with the data from 1 to 7.6 MeV. The following quantities are tabulated: differential elastic scattering cross sections at 4.00, 4.60, 5.00, 5.56, 6.12, 6.53, 7.00, and 7.55 MeV; differential cross sections for inelastic scattering to the 0.846-MeV level at 4.60, 5.00, 5.56, 6.12, 6.53, and 7.55 MeV; angle-integrated compound elastic and inelastic cross sections at 1.0, 1.5, 2.0, 2.5, 3.0, 3.25, 3.5, 3.75, 4.0, 4.5, 5.0, 5.5, 6.2, 6.6, and 7.6 MeV; total, elastic, and reaction cross sections at 4.00, 4.60, 5.00, 5.56, 6.12, 6.53, and 7.55 MeV; and gamma-ray production cross sections for neutron energies from 1 to 7.6 MeV. Author (NSA)

N68-37466 Duke Univ., Durham, N. C.
MILLIMETER WAVE ROTATIONAL SPECTRUM OF HSSH
Gisbert Fritz Winnewisser (Ph.D. Thesis) 1967 182 p 2 refs
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-2753

The millimeter wave spectrum of the very slightly asymmetric top molecule hydrogenpersulfide H_2S_2 has been measured in the frequency region from 70 Gc/sec to 200 Gc/sec. The absorption spectrum was obtained with a fast-flow millimeter wave spectrometer, as a result of study of the discharge products of hydrogensulfide H_2S. The fact that disulfane was found in the discharge suggests that its creation is a secondary process caused by recombination of SH in between the discharge arrangement and the detecting microwave beam. This means the free radical SH is produced in sufficient concentration for measuremem of its Λ-type spectrum. The rotational absorption lines of the ground state as well as those of the first excited states (first excited torsional state and first excited S–S stretch state) have been measured. The rotational spectrum of the first excited states shows inversion splitting. Dissert. Abstr.

N68-37472 Connecticut Univ., Storrs.
NONADIABATIC COUPLING OF NUCLEAR AND ELECTRONIC MOTION IN SYMMETRIC RESONANCE CHARGE EXCHANGE
Simon Bernard Schneiderman (Ph.D. Thesis) 1967 159 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-1404

Symmetric resonance charge exchange in the proton on hydrogen atom system is treated in the impact parameter version of the method of perturbed stationary states using a quasi-molecular orbital basis. The orbital basis differs in that: (1) the electronic wave functions incorporate a form of velocity dependence which in addition to accounting for translational effects also insures orthonormality of the basis; and (2) these basis functions are quantized along nonrotating axes. The use of nonrotating basis functions results in a form of the two-state approximation devoid of the rotation-related defects of earlier forms and which gives, when coupled with the velocity correction factors, an expression for the probability of charge exchange which matches in form that obtained from experiment. Quantization along space-fixed axes and the incorporation of velocity-dependent correction terms are both found to be necessary. Dissert. Abstr.

N68-37474 Michigan State Univ., East Lansing.
NUCLEAR SPIN LATTICE RELAXATION OF SEVERAL NUCLEI IN ANTIFERROMAGNETIC RUBIDIUM MANGANESE CHLORIDE DI-HYDRATE
Charles Emery Taylor (Ph.D. Thesis) 1967 p 116
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-4225

Rubidium manganese chloride dihydrate is a triclinic crystal which becomes antiferromagnetic below 2.24°K. Measurements of the nuclear spin-lattice relaxation time T_{1n} have been made as a function of temperature for four nuclei, Rb^{87}, Rb^{85}, Cl^{35}, and H^1, in the temperature range from 1.6°K to 0.45°K, and in one instance for Rb^{87}, to 0.32°K. Standard rf pulse techniques were used, and the experiments were carried out in zero external magnetic field. The temperature dependence of T_{1n} was qualitatively the same for all four lines, and a least squares fit to the data for each line was made using a theory based on a two magnon Raman relaxation mechanism. The following conclusions are drawn: (1) Relaxation occurs via an intrinsic two magnon Raman process and is not due to the presence of paramagnetic impurities. (2) The temperature dependence of T_{1n} is small. (4) The use of the small k approximation is not consistent with the presence of a large energy gap in the magnon spectrum. Dissert. Abstr.

N68-37483# Argonne National Lab., Ill.
NUCLEAR STRUCTURE CALCULATIONS
R. D. Lawson May 1968 18 p
(Contract W-31-109-ENG-38)
(ANL-7439) CFSTI: HC$3.00/MF$0.65

The structure of the shell-model wave functions for low-lying states of even–even nuclei is examined, and it is shown why one might hope to reproduce energies and some transition rates using the BCS and two-quasiparticle approximations to describe single-closed-shell nuclei. It is demonstrated, by comparison with exact calculations on the nickel isotopes, that if the physical quantity one wants to calculate is not symmetric about $\bar{N}$ (where $\bar{N}$ is the number of nucleons in the physical system one wants to describe) large errors result when the BCS and two-quasiparticle wave functions are use. To remedy this deficiency, it is necessary to project out of these wave functions the part describing a system with N particles, normalize this part, and then use the normalized

projected eigenfunction to calculate the physical quantity of interest. It is also shown that if one does only a two-quasiparticle calculation for the low-lying excited states, one can only reliably predict the B(E2) between the ground state and first 2^+ nuclear leve.
Author (NSA)

N68-37491# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THEORY OF POPULATION OF EXCITED LEVELS OF ATOMS AND IONS AND ITS APPLICATION TO DENSITY FROM RELATIVE LINE INTENSITIES OF THE IONS C-4, N-5, AND O-6
Szymon Suckewer 1967 61 p 17 refs
(INR-859)

The theory of population of excited levels for atoms and ions is given for stationary, nonthermal plasmas. Simplified expressions are obtained from which populations of the levels 2P, 3P, and 3D were determined for the ions C-4, N-5, and O-6. It is shown that the populations obtained by this method are in a very good agreement with the populations determined directly from the balance of excitation and de-excitation processes. The plots are given, which enable the determination of electron density and temperature from relative intensities of three chosen lines from a given ion.
Author (NSA)

N68-37492# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
BEAM MATCHING BETWEEN 510-keV PROTON INJECTOR AND 10-MeV LINEAR STRONG FOCUSING ACCELERATOR
E. Dziura 1967 26 p 5 refs
(INR-875/SLBAL/PL)

Optical parameters of the beam matching system between a 510-keV proton injector and a 10-MeV linac are determined. Taking into consideration the properties of the optical channel of the linac strong focusing system, two magnetic triplet arrangements allowing precise matching of the source emittance to the acceptance of the linac were chosen. A range of magnetic lens gradients as a function of focal strengths was computed and is illustrated graphically.
Author (NSA)

N68-37493# Los Alamos Scientific Lab., N. Mex.
THE MEAN NUMBER OF PROMPT NEUTRONS IN THE FISSION OF U-235 AND Th-232 INDUCED BY NEUTRONS WITH ENERGY UP TO 3.3 MeV
L. I. Prokhorova and G. N. Smirenkin Jul. 1968 15 p 22 refs Transl. of Russian Rept. FEI-107, 1967
(LA-TR-68-20) CFSTI: HC $3.00/MF $0.65

A battery of 36 ^{10}B F_3 counters in a paraffin block was used to measure ν of ^{235}U and ^{232}Th. The fission events were recorded by a multilayer ionization chamber. The measurements of $\overline{\nu}$ for ^{232}U were made within the range of neutron energies from 1.5 to 3.3 MeV; measurements of $\overline{\nu}$ for ^{238}U were made in the energy interval from 0.4 to 3.3 MeV at an interval of 0.2 MeV. The accuracy of the values of $\overline{\nu}$ is about 1.5% for ^{238}U and about 2.5% for ^{232}Th. The measurements were carried out by comparing with the thermal value of $\overline{\nu}$ of ^{235}U.
Author (NSA)

N68-37495# Brookhaven National Lab., Upton, N. Y.
COHERENT PRODUCTION OF POSITIVE PION POSITIVE PION NEGATIVE PION IN DEUTERIUM BY 8 GeV/c POSITIVE PION
A. M. Cnops, P. V. C. Hough, F. R. Huson, I. R. Kenyon, J. M. Scarr et al 1968 16 p 9 refs Presented at 14th Inter. Conf. on High Energy Phys., Vienna, 28 Aug.–5 Sep. 1968 Supported in part by AEC
(BNL-12677; CONF-680809-8) CFSTI: HC $3.00/MF $0.65

There were 45,000 events measured from the exposure of a deuterium bubble chamber to a beam of 8-GeV/c mesons (π^+). The channels studied were $\pi^+ + d \rightarrow 2\pi^+ + \pi^- + d$, $\pi^+ + d \rightarrow 2\pi^+ + \pi^- + n + p$, and $\pi^+ + d \rightarrow \pi^+ + \pi^- + \pi^0 + 2p$. In the coherent events a diffractively produced $\pi\rho$ peak was observed which has characteristics compatible with the low-mass $\pi\rho$ system produced in pion–nucleon interactions and which has a J^{PG} of 1^+. The mass distribution fits a Breit–Wigner distribution with a mass of 1.16 GeV and a width of 0.34±0.025 GeV. The peak is interpreted as due to a Deck type mechanism.
NSA

N68-37498 California Univ., San Diego.
INTERMEDIATE STRUCTURE IN RESONANCES
Gerald Lew Payne (Ph.D. Thesis) 1967 196 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-3248

The effects of two-particle-one-hole states on the elastic cross section for the scattering of neutrons from nuclei are studied. It is suggested that these states are responsible for the intermediate resonances observed in the averaged cross section. The intermediate resonances are observed when the averaging width is larger than the widths and spacings of the compound nucleus states but smaller than the width of the structure in the optical model cross section. The calculations are done for nuclear matter. Also calculated are the widths for a number of spherical nuclei using a shell model basis. For light nuclei and doubly magic nuclei the resonances due to the two-particle-one-hole states are observable. For medium weight nuclei ($A \approx 50$) the states are observable only at low energies. In heavy nuclei the resonances are too damped to be observed.
Dissert. Abstr.

N68-37503 Virginia Polytechnic Inst., Blacksburg.
A MEASUREMENT OF SOME ENERGY LEVELS AND LIFETIMES FOR COLLISIONALLY EXCITED BORON
Marvin LeRoy Luther (Ph.D. Thesis) 1967 184 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-2058

A source capable of producing isotopically pure spectra has been utilized to examine the spectrum of highly excited boron in the region from 3400 to 7200 Å. The technique has the further advantage of enabling a direct measurement of the lifetimes of the excited states. The source is capable of producing a wide variety of ionization levels and excited states at one time. It consists of a radiating beam of particles from a Van de Graaff accelerator which are electronically excited by collisions in a thin carbon foil. The accelerator beam, after passing through the foil, is viewed at right angles to its path by a one-meter Czerny–Turner spectrograph of moderate speed (f/8.5) and dispersion (16.84 A/mm). The entrance slit is aligned parallel to the beam which is collimated so as to be only .80 mm high and 6.25 mm deep. Line positions were observed and measured by comparision with a neon spectrum.
Dissert. Abstr.

N68-37517# Brookhaven National Lab., Upton, N.Y.
GAMMA-RAY SPECTROSCOPY IN LIGHT NUCLEI: Na-22, AN EXAMPLE
J. W. Olness 1968 42 p 32 refs Presented at 3d Intern. Symp. on the Struct. of Low-Medium Mass Nuclei, Lawrence, Kans.
(BNL-12621; CONF-680440) CFSTI: HC $3.00/MF $0.65

The applicability of some techniques of γ-ray spectroscopy to the study of light nuclei is demonstrated using some investigations of ^{22}Na as an example. ^{22}Na was formed in its various states using reactions such as $^{19}F(\alpha,n)^{22}Na$ and $^{20}Ne(^3He,p)^{22}Na$ as well as β decay to ^{22}Na. The investigations that are discussed deal with high-resolution measurements of γ spectra, β decay to states of ^{22}Na, angular correlation studies, linear polarization of γ rays, Doppler-shift attenuation measurements of lifetimes, and measurements of magnetic moments.
NSA

N68-37518# Brookhaven National Lab., Upton, N.Y.
EXPERIMENTAL REVIEW OF MESON RESONANCES DECAYING INTO KAON-ANTIKAON STATES
Kwan Wu Lai 1968 32 p 23 refs Submitted for publication Presented at Conf. on Exptl. Meson Spectry., Philadelphia
(CONF-680428-7; BNL-12611) CFSTI: HC $3.00/MF $0.65

The isosinglet and isotriplet mesons having the $K\overline{K}$ decay mode are reviewed. The mesons are chosen which either are less well established or have significant recent developments. The production reactions and decays of these mesons are briefly summarized. NSA

N68-37519 Indiana Univ., Bloomington.
BETA-GAMMA CORRELATION MEASUREMENTS OF SOME ANOMALOUS BETA TRANSITIONS AND THE DESIGN OF A MAGNETIC SPECTROMETER FOR CORRELATION STUDIES
Fred Kramer Wohn (Ph.D. Thesis) 1967 218 p
Available from Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-2378

The beta-gamma directional correlations of four beta transitions were measured with a shaped field magnetic spectrometer. The directional correlations of the 485 KeV allowed transition of Co^{58}, the 435 KeV first forbidden transition of Ce^{141}; and the 530 KeV allowed transition of Ag^{110m} were found to be isotropic within the experimental errors. The 662 KeV allowed transition of Cs^{134} was found to have an energy dependent directional correlation for the cascade $4+(\beta)4+(\gamma)2+$. A magnetic spectrometer employing a new approach to double focusing was designed for angular correlation studies. The field shape varies essentially as $1/r$ in the direction normal to the source-detector axis. The focusing properties and dispersion were both calculated numerically and measured as a function of the emission angles from the source. The transmission, resolution, and luminosity of the instrument were measured for various source, detector slit, and entrance baffle sizes. Dissert. Abstr.

N68-37534 European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1968 CERN SCHOOL OF PHYSICS, VOLUME 1
8 Jul. 1968 369 p 117 refs Conf. held at El Escorial, Spain, 26 May–8 Jun. 1968
(CERN-68-23, V. 1)

CONTENTS:

1. TOPICS IN ADVANCED QUANTUM MECHANICS AND FIELD THEORY A. Galindo (Madrid Univ., Spain) p 1–128 refs (See N68-37535 24-24)

2. WEAK INTERACTIONS P. Pasqual (Valencia Univ., Spain) p 129–234 refs (See N68-37536 24-24)

3. HIGHER SYMMETRIES A. Morales (Zaragoza Univ., Spain) p 235–364 refs (See N68-37537 24-24)

N68-37535 Madrid Univ. (Spain). Dept. of Theoretical Physics.
TOPICS IN ADVANCED QUANTUM MECHANICS AND FIELD THEORY
A. Galindo *In* CERN Proc. of the 1968 CERN School of Phys., Vol. 1 8 Jul. 1968 p 1–128 25 refs (See N68-37534 24-24)

Relativistic systems and wave equations, scattering and decay processes, and quantized fields are considered in a review of lectures on quantum mechanics and field theory presented by the CERN School of Physics. Basic Poincaré transformations are treated as symmetry operations with emphasis on elementary relativistic systems; and spin 0, 1/2, and 1 articles realizations are included. The S-matrix description of reaction and decay processes is discussed and formulas for determining cross sections and partial lifetimes are deduced. Local interaction, Feynman graphs, and the Lagrangian approach are considered for quantized fields, and gamma matrices, Fock space techniques, and two-body phase space integrals are treated. M.W.R.

N68-37536 Valencia Univ. (Spain). Dept. of Theoretical Physics.
WEAK INTERACTIONS
Pedro Pasqual *In* CERN Proc. of the 1968 CERN School of Phys., Vol. 1 8 Jul. 1968 p 129–234 85 refs (See N68-37534 24-24)

Beta and muon decay, semileptonic decays of hyperons, and nonleptonic decays of hyperons and kaons are among the weak interaction studies reviewed. Attention is given to universal weak interactions, conserved vector current, and partially conserved axial current. Cabibbo's theory and transformation properties of hadronic current under SU(3) are discussed, and Cabibbo's method is used for the calculation of decay rates. M.W.R.

N68-37537 Zaragoza Univ. (Spain). Dept. of Nuclear Physics.
HIGHER SYMMETRIES
A. Morales *In* CERN Proc. of the 1968 CERN School of Phys., Vol. 1 8 Jul. 1968 p 235–364 17 refs (See N68-37534 24-24)

The SU(3) group and its experimental consequences were studied, and mathematical aspects of SU(3) were analyzed mainly through the use of its Lie Algebra. Unitary symmetry is applied to strong, weak, and electromagnetic interactions to give an account of the main features of SU(3) in elementary particle physics. Quarks, particles, and resonances; the Gell-Mann–Okubo mass formula and baryon and meson states; and Yukawa coupling, meson–baryon scattering, and baryon resonance production are discussed for strong interactions. Tensor behavior of the electromagnetic current under SU(3), U-spin and its invariance in electromagnetic interactions, baryon magnetic moments, and electromagnetic mass differences are reviewed. M.W.R.

N68-37538 European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1968 CERN SCHOOL OF PHYSICS, VOLUME 2
8 Jul. 1968 161 p 161 refs Conf. held at El Escorial, Spain, 26 May–8 Jun. 1968
(CERN-68-23, V. 2)

CONTENTS:

1. HIGH-ENERGY NEUTRINO INTERACTIONS D. H. Perkins (Oxford Univ., England) p 365–430 refs (See N68-37539 24-24)

2. THREE LECTURES ON BARON RESONANCES M. Ferro-Luzzi p 431–496 refs (See N68-37540 24-24)

3. PHENOMENOLOGY OF CP VIOLATION IN K^0 DECAYS J. Iliopoulos p 497–521 refs (See N68-37541 24-24)

N68-37539 Oxford Univ. (England). Nuclear Physics Lab.
HIGH-ENERGY NEUTRINO INTERACTIONS
D. H. Perkins *In* CERN Proc. of the 1968 CERN School of Phys., Vol. 2 8 Jul. 1968 p 365–430 45 refs (See N68-37538 24-24)

Rationale for high energy neutrino experiments is discussed, and a historical background is presented on the semileptonic and leptonic interactions that affect neutrino processes. Attention is given to a hypothesis of the current-current interaction, conserved vector currents and the universal Fermi interaction, and Cabibbo theory. Neutrino reactions, both elastic and inelastic, involving hadron currents are considered, including pion production, hyperon production by antineutrinos, and sum rules. Lepton conservation, muon number conservation, the intermediate vector boson and W-boson production, lepton currents, and neutrino and electromagnetic scattering are discussed. Total inelastic cross sections on nucleons are also considered. M.W.R.

N68-37540 European Organization for Nuclear Research, Geneva (Switzerland). Track Chambers Div.
THREE LECTURES ON BARYON RESONANCES
M. Ferro-Luzzi *In its* Proc. of the 1968 CERN School of Phys., Vol. 2 8 Jul. 1968 p 431-496 31 p (See N68-37538 24-24)

Hyperon resonances, partial wave analyses, and SU(3) applications are reviewed in three lectures on baryon resonances. Production and formation experiments, partial wave decomposition, and the Breit-Wigner resonance formula are considered in detail. Total $\bar{K}N$ cross sections between 2 and 3 GeV/c indicate miniscule resonant enhancements as compared to those near 1 GeV/c, and various studies with such a system are reviewed in relation to hyperon resonances. Partial wave analysis for the pion-nucleon system is considered, and a procedure is given that appears to be of value in the case of small amplitudes. Existence, requirements, and composition of baryon multiplets are treated in the third lecture. A model is presented that agrees with most of the experimental data although it has discrepancies as to the correctness of specific multiplet composition. M.W.R.

N68-37541 European Organization for Nuclear Research, Geneva (Switzerland). Theoretical Study Div.
PHENOMENOLOGY OF CP VIOLATION IN KAON DECAYS
J. Iliopoulos *In its* Proc. of the 1968 CERN School of Phys., Vol. 2 8 Jul. 1968 p 497-521 85 refs (See N68-37538 24-24)

Mass matrix, unitarity relations, TCP relations, eigenstates of long-lived and short-lived states are considered for the kaon-antikaon system; and two pion, leptonic, three eta, and other decay modes related to CP violation in kaon decay are discussed. A review of the present experimental situation gives some values, most of which require further confirmation. M.W.R.

N68-37542 Maryland Univ., College Park.
CONSEQUENCES OF THE MODIFIED PARTIALLY CONSERVED AXIAL-VECTOR CURRENT HYPOTHESIS IN PHOTOPION PRODUCTION
Myron Leonard Tapper (Ph.D. Thesis) 1967 96 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-3389

The photopion production process $\gamma + N \rightarrow N + \pi$ is studied in connection with the partially conserved axial-vector current hypothesis which is suitably generalized to deal with electromagnetic interactions. Some relations are derived between the nucleon magnetic moments and certain analytically continued isotopic-spin components of the photopion amplitude. One of these relations contains an amplitude which is related to an electromagnetic transition involving only the isoscalar part of the photon. This amplitude is calculated from the ρ-dominance model in the crossed photoproduction channel $\gamma + \pi \rightarrow N + N$. With this model the ρ-π-γ vertex is calculated in terms of the ρ-γ vertex, the renormalized π-N coupling constant and the ratio of isoscalar and isovector nucleon magnetic moments. Dissert. Abstr.

N68-37547 Virginia Univ., Charlottesville.
INTERNAL PAIR FORMATION IN NUCLEAR BETA-PROCESSES
Keith Carlton Richards (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3121

In the β-decay of Y^{90} and N^{16}, branching ratios for the first excited state can be determined by observing the pairs which are emitted when this excited state decays to the ground state. This is the case for both the excited state and the ground state have $J^{\pi}=0+$. This determination may be complicated by internal pair information accompanying the ground state β-decay. This process has been calculated. It is found that the ratio of pairs from the decay of the excited state to pairs from internal pair formation accompanying the ground state β-decay is 5.9×10^3 and Y^{90} and 1.6×10^2 in N^{16}. Internal pair formation in K-capture has also been calculated. A typical result is that for At^{210}. Here, the ratio of positrons from positron decay to positrons from internal pair formation accompanying K-capture is 5.0×10^3. The relative contribution of the detour transitions to the total decay rate characterizing these internal processes is discussed. Dissert. Abstr.

N68-37548 Princeton Univ., N.J.
CORE POLARIZATION EFFECTS IN MASS 15 AND MASS 17
Agam Prakash Shukla (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-2518

The effects of residual interaction are investigated in (O^{16} ± 1 nucleon) nuclei. Wave functions of the $1^-/2$ and $3^-/2$ states of O^{15} and N^{15} are constructed by mixing the single hole spherical and (2p-3h) deformed configurations. The even parity states of mass 15 are constructed by mixing the (1p-2h) and (3p-4h) deformed states. The Nilsson model is used for constructing the intrinsic states and the physical, deformed states are obtained by angular momentum projection. Spectroscopic factors were calculated for the odd parity states of O^{17} in the deuteron stripping reaction $O^{16}(d,p)O^{17}$. It is concluded from this calculation and on the basis of previous work that the low lying odd parity states of O^{17} are predominantly (2p-1h). The calculated spectroscopic factors are in poor agreement with measured values. The relevance of the weak coupling model as an alternative to constructing these states, is discussed. Dissert. Abstr

N68-37560 Princeton Univ., N. J.
DOUBLE CHARGE EXCHANGE SCATTERING OF POSITIVE π MESONS ON COMPLETE NUCLEI
Paul Edward Boynton (Ph.D. Thesis) 1967 p 170
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-2461

The differential cross section for the reaction $\pi+ + N(z, n) \rightarrow \pi- + X$ was measured at lab angles 7.5° and 15°, with incident 200 MeV $\pi+$ derived from the external proton beam of the UCLRL 184" synchrocyclotron. Several target nuclei were employed; V^{51}, Zr^{90}, Li^7. The momentum analysis of the final state $\pi-$ was accomplished with a magnetic spectrometer using digitized wire spark chambers for track location. The discrepancy between theory and experiment is discussed in terms of a pion-complex nucleus interaction model including effects of higher order inelastic scattering. Dissert. Abstr.

N68-37561 Tennessee Univ., Knoxville.
TEST OF DETAILED BALANCE IN THE REACTION OXYGEN 16 DEUTERON ALPHA NITROGEN 14 AND ITS REVERSE
Stephen Thomas Thornton (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3770

Of greatest interest to the present experiment is the suggested possibility of a small C and T violation in the strong interaction or a large violation of C and T invariance in the electromagnetic interaction. The reaction $^{16}O(d,\alpha)^{14}N$ and its inverse were chosen for several reasons. First of all, at the bombarding energies available with the Oak Ridge National Laboratory 5.5 million volt Van de Graaff accelerator there are several open channels for these reactions. Secondly, both targets are gases of high natural isotopic purity, thus making them highly suitable for study with the precision gas scattering chamber. Absolute differential cross sections were measured at three different energies (E_{lab} (deuteron) = 4.41 MeV, 4.57 MeV, and 4.71 MeV) for both inverse reactions at center of mass scattering angles near 162°. Differential cross sections at backward angles were measured in order to limit interfering effects of reaction amplitudes. Dissert. Abstr.

N68-37572# Akademiya Nauk URSR, Kharkov. Teknicheskii Institut.

SOME QUESTIONS ON THE THEORY OF EXCITATION OF OSCILLATORY AND ROTATING STATES OF DIATOMIC MOLECULES [NEKOTORYE VOPROSY TEORII VOZBUZHDENIYA KOLEBATELNYKH I VRASHCHATEL' NYKH SOSTOYANII DVUKHATOMNYKH MOLEKUL]

Yu. D. Oksyuk 1966 88 p 130 refs In RUSSIAN (NP-17519)

Oscillatory and rotational states of diatomic molecules are of great importance for the study of the kinetics of relaxation phenomena in gases, aerodynamics at supersonic velocities, low temperature plasma, elementary processes in the upper atmosphere, etc. For these reasons, the effective cross section of vibrational and rotational transitions resulting from collision of molecules with electrons was investigated, extending the Born–Oppenheimer approximation to the range of continuous spectra, and determining the effective excitation cross section of these states, as they relate to the dissociation of molecules by collision with heavy particles and in the β decay. By using the adiabatic approximation for examining the collision of molecules with electrons, a generalized expression was obtained for the determination of the effective cross section of these transitions in diatomic molecules at the ground electron state; the same approximation was also applied to calculate the various rotational transitions of N_2, H_2, and O_2 molecules in the 0- to 25-eV range. The results made it possible to clarify experimental data of electron scattering in molecular gases. Similarly, the effective cross section of excitation of these states, and dissociation of N_2, NaCl, and HgH molecules for x collision with heavy particles was also calculated. NSA

N68-37576# Argonne National Lab., Ill.

ANGULAR DISTRIBUTION OF FRAGMENTS OF PHOTOFISSION NEAR THE THRESHOLD

S. P. Kapitsa and Yu. M. Tsipenyuk Jun. 1968 6 p 4 refs Transl. into ENGLISH from Russian Rept. FEI-73, 1966 (ANL-TRANS-639) CFSTI: HC $3.00/MF $0.65

The results of an investigation of the photofission of ^{240}Pu, ^{242}Pu, ^{232}Th, and ^{238}U at bremsstrahlung endpoint energies of 5 to 8 MeV are presented. An interpretation of the data is outlined. NSA

N68-37577 Cornell Univ., Ithaca, N. Y.

A QUANTUM THEORY OF EQUATION OF STATE FOR SOLID HYDROGEN

Shi-yu Wu (Ph.D. Thesis) 1967 111 p Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-3521

A variational calculation of the ground state energy of the molecular crystalline hydrogen has been carried out, with special emphasis on the effect of correlation between the motions of the particles. The principal purpose has been to obtain the equation of state for the solid hydrogen at absolute zero temperature over a wide range of densities, rather than to achieve a description of either the low temperature phase changes, or probable high pressure metallic phase. In fact this is a zero temperature theory, but may be applied to finite temperatures to thermodynamic description of phase transitions whenever $p\Delta V >> kT$. The variational form of the energy is obtained by truncating the cluster expansion of the ground state energy. Dissert. Abstr.

N68-37595 Iowa State Univ. of Science and Technology, Ames.

PRECISE MEASUREMENT OF THE INTERNAL CONVERSION COEFFICIENT OF THE 45 keV TRANSITION IN U-236

Charles Lewis Duke (Ph.D. Thesis) 1967 84 p Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 62-2814

The total internal conversion coefficient of the 45 keV $2^+ \rightarrow 0^+$ transition in U236 was measured by analysis of photon spectra observed, using a well type NaI(Tl) detector, in coincidence with the 5.115 MeV alpha group from the decay of Pu240. The alpha spectra from the gating detector were analyzed on a computer using a least squares curve fitting program to correct for the contribution to the gating from the 5.159 MeV ground state alpha group. The NaI(Tl) photon efficiency for the transition was calculated using a computer program that included angular correlation effects. The result for the total internal conversion coefficient of the 45 keV E2 transition in U236 was 607 ± 29. This value is in agreement with the theoretical calculations of Rose and Sliv and Band. A pile-up rejection circuit developed for this investigation is described. Dissert. Abstr.

N68-37601# Brookhaven National Lab., Upton, N. Y.

PROPOSED REPORT OF INTERNATIONAL UNION OF CRYSTALLOGRAPHY COMMISSION ON CRYSTALLOGRAPHY APPARATUS SINGLE CRYSTAL INTENSITY PROJECT. 1: INTEREXPERIMENTAL AGREEMENT

S. C. Abrahams (Bell Telephone Labs., Murray Hill, N. J.), C. W. Hamilton and A. Mc L. Mathieson (Commonwealth Sci. and Ind. Res. Organ., Clayton, Australia) 28 Jun. 1968 45 p 11 refs Presented at Meeting on Accurate Determinaton of X-ray Intensities and Struct. Factors, Cambridge, 24–28 Jun. 1968 (BNL-12559; CONF-680619-1) CFSTI: HC $3.00/MF $0.65

Sixteen laboratories have measured 7146 individual structure factors with ($\sin\theta/\lambda \leq 0.5$ Å^{-1}), using crystals of *D*(+)-tartaric acid grown from a single batch. All current diffractometer methods are represented in this project. The instruments included 4-circle, normal beam, and equi-inclination diffractometers. Unfiltered, singly filtered, balanced-filtered, and crystal-monochromatized Cu*K* or Mo*K* radiation were used. A conventional analysis of variance treatment indicates that there are significant differences among the results of seventeen experiments; these differences are manifested in highly significant systematic errors that are correlated with scattering angle, with intensity, and with the three Miller indices. The average interexperimental agreement is 8.7% for all experiments; excluding the two that differ most from the average, the agreement becomes 6.1%; a modal group of five experiments has an interexperiment agreement of 4.1%. Several common sources of error have been tentatively identified. Author (NSA)

N68-37602 Rochester Univ., N. Y.

MASS STOPPING POWERS ESPECIALLY OF PLASTICS IN RELATION TO THEORY

Frederick Thomas Cross (Ph.D. Thesis) 1967 174 p Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-3949

The primary purpose of the experiment is the measurement of mass stopping powers of plastics. The air pressure in chambers of graphite, aluminum, copper, and a few graphited plastics was reduced from atmospheric to approximately 15 cm Hg. The variations with pressure of the ionization currents are compared, according to a method by Whyte, in order to deduce the mass stopping powers. Copper, aluminum, and graphite are "associative" ionization chambers providing a check on the data and a comparison to previous measurements. The experimentally determined mass stopping powers and the variation with pressure of the ionization currents are compared to the predictions of the early Bragg–Gray–Laurence theory, and the much later and improved theory of Spencer and Attix. In the main, the mass stopping powers of graphite and the plastics are found to be predicted equally well by either theory whereas the Spencer–Attix theory is the better of the two for aluminum and copper. Dissert. Abstr.

N68-37613 Virginia Univ., Charlottesville.
MAGNETIC INTERNAL COMPTON COEFFICIENTS
Harry Thomas Williams, Jr. (Ph.D. Thesis) 1967 76 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-3130

A calculation of the transition rate for the internal Compton effect for magnetic multipoles is done, considering the major effects of the nuclear Coulomb field. The internal Compton effect is equivalent to an internal conversion process accompanied by bremsstrahlung of the conversion electron. The initial and final states of the electron are represented by solutions to the Dirac equation in a Coulomb field, and the intermediate state summation is replaced by the plane wave propagator. The assumption of a point nucleus is made so that the internal Compton coefficient, which is the branching ratio of the internal Compton effect to internal conversion, is independent of nuclear matrix elements. The calculation is restricted to electrons initially in the atomic K shell, and no screening is taken into account. The coefficient is expressed as infinite sums over the angular momentum of the final state electron and photon. Dissert. Abstr.

N68-37616 Virginia Univ., Charlottesville.
NEUTRON PHOTOPRODUCTION CROSS SECTIONS FOR NICKEL AND SILVER
Douglas Stratton Fielder (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3110

The absolute (γ,n) cross sections of nickel and silver have been measured using the bremsstrahlung from the 70 MeV electron synchrotron at the University of Virginia. The nickel and silver yield curves were measured from 10.25 MeV to 25 MeV in 0.25 MeV increments and from 9 MeV to 25 MeV in 0.5 MeV increments, respectively. The absolute measurements were made utilizing a Halpern type detection arrangement, a modified version of a type of ionization chamber designed at the National Bureau of Standards, and a Ra–Be source of known neutron flux. A minimum of 18 yield curves were measured for each element with an average standard error of less than 0.7% in the averaged yield curves. Dissert. Abstr.

N68-37619 North Carolina Univ., Chapel Hill.
THE WEYL COEFFICIENTS FOR THE UNITARY GROUPS U(N)
Klaus Jochen Lezuo (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-2206

The Weyl coefficients are defined as the matrix elements of the Weyl operators in the unitary groups U(n). Knowledge of the Weyl coefficients makes possible to derive those symmetry relations of the Wigner coefficients which result from the Weyl group. They are of physical interest and consititue a generalization of the "U-spin" techniques, familiar in the calculation of scattering amplitudes in elementary particles physics. It is shown that the problem of calculating the Weyl coefficients can be reduced to finding the matrices which transform the states of the Gelfand basis into the states of the Weyl basis and vice versa. This is the question of finding a realization of the states in terms of the boson calculus. As such, it is a general problem in the theory of the unitary groups, quite independent of the properties of any particular operator. Dissert. Abstr.

N68-37620 Indiana Univ., Indianapolis.
THE MEASUREMENT OF BETA SPECTRA BY COMBINED MAGNETIC MOMENTUM
Sin-Tao Hsue (Ph.D. Thesis) 1967 69 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-2304

In measuring beta spectra with a magnetic spectrometer, there is always some distortion due to instrumental scattering. The presence of scattering increases the uncertainty in determining the end point of a beta spectrum. The distortion is especially large in measuring the weak beta transitions in the presence of intense ones. By using energy sensitive detectors at the focus of a magnetic spectrometer, it is possible to demand energy selection as well as momentum selection of the electrons. The additional energy selection can be used to eliminate scattering electrons in the spectrometer. The details of this method have been worked out for solid-state detectors with a 180° focusing, shaped magnetic field spectrometer. Dissert. Abstr.

N68-37631 Maryland Univ., College Park.
ELASTIC AND CHARGE REARRANGING DIFFERENTIAL CROSS-SECTIONS FOR COLLISIONS OF H^+ AND H_2^+ WITH WATER MOLECULES
Peter George Cable (Ph.D. Thesis) 1967 132 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-3343

The modulated crossed beam apparatus which has been constructed enables one to study the energetics and product ion angular distributions of ion-neutral elastic and charge rearranging collisions. The essential components of the apparatus included an ion source, a modulated molecular beam source for condensable gases, and a product ion energy analyzer and detector system. Amplification of the scattering signal and phase sensitive detection were employed to achieve good signal to noise ratio. The collisions of H^+ and H_2^+ with H_2O molecules over an incident ion energy range 200 eV $\leq E \leq$ 500 eV were studied. Contributions from both elastic and inelastic scattering were observed and measured. The elastic scattering data were used to deduce the form of the repulsive part of the ion-molecule potential experienced in close collisions. Dissert. Abstr.

N68-37638# Uppsala Univ. (Sweden). Inst. for Physics.
A SEARCH FOR AFTEREFFECTS OF THE IN^{111} ELECTRON CAPTURE DECAY ON THE CD^{111} γ–γ CORRELATION
Frederick Falk, Alf. Linnfors, and John Erik Thun Feb. 1968 22 p refs
(UUIP-573)

Aftereffects and their detection are discussed briefly. Three indium compounds (In_2O_3, In_2S_3, and $In(C_9H_7NO)_3$) were examined for evidence of aftereffects on the 173–247 keV γ–γ correlation of the ^{111}In electron capture decay. The main experimental method was the application of a 23 kG decoupling magnetic field. The source temperature was also changed. No aftereffects were found, although the correlation in the third case seems to be attenuated below the hard core value. Author (NSA)

N68-37650 West Virginia Univ., Morgantown.
NEUTRON INELASTIC SCATTERING WITH THE WEST VIRGINIA UNIVERSITY ELECTROSTATIC ACCELERATOR
Paul R. Errington (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-10848

Details are given on the design, installation and applications of the Van de Graaff electrostatic accelerator. Shielding and safety problems are discussed and their solutions are also discussed briefly. The use of the accelerator for both fast and thermal neutrons is described, along with the inelastic scattering of neutrons from Fe^{56} and Cr^{52}. The angular distributions of the .84 MeV gamma from the iron isotope and the 1.4 MeV gamma from the chromium isotope were measured. These were compared to a theoretical calculation based on the statistical model of the nucleus. The theoretical calculations were completed for neutron angular momentum values of 4, 5, and 6. Also included is a guide for operation of the accelerator. Dissert. Abstr.

N68-37661 Duke Univ., Durham, N. C.
MULTIPION PRODUCTION BY POSITIVE PION IN HYDROGEN AT 1.48 BeV/c
Zee-Ming Ma (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-3436

Multiple pion production by π^+ in hydrogen at 1.48 BeV/c beam momentum has been studied using the BNL 20-inch Hydrogen Bubble Chamber and the Alternating Gradient Synchrotron. The N^* (1236) is produced rather copiously, the tail effect of the N^* ρ^0 which dominates the $\pi^+ p \pi^+ \pi^-$ final state in experiments of higher momenta is observed. No evidence existed in this experiment for a I=2 Meson resonance. The four prong total cross section is 3.14±.07 mb. The evidence exists for the $\pi^+ p \pi^+ \pi^-$ final state undergoing resonance at 1.92 BeV center of mass energy. The cross section for N^* (1920) $\rightarrow \pi^+ p \pi^+ \pi^-$ is 0.7±0.2 mb from a simple-minded background subtraction method. The production cross sections in this experiment are given. Dissert. Abstr.

N68-37662 Colorado Univ., Boulder.
GROUP DYNAMICS OF ELEMENTARY PARTICLES
Hagen Michael Kleinert (Ph.D. Thesis) 1967 160 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-2655

Particle interactions can be described by means of simple group operations in noncompact Lie groups. Prescriptions for the structure of these group operations are formulated which are motivated by the study of simple models, in particular of the dynamics of the hydrogen atom. If they are fulfilled we call the structure group dynamics. Neglecting first internal symmetries, a few simple models are investigated on which group dynamics is possible. The group O(3,1) turns out to describe the coupling of pseudoscalar mesons, O(4,2) that of photons to baryons quite well: The pionic decay rates of baryon resonances up to spin 19/2 and the electromagnetic form factors of the nucleons are predicted in good agreement with experiment. Dissert. Abstr.

N68-37664 Michigan State Univ., East Lansing.
AN INVESTIGATION OF (p,d) REACTIONS IN 1p SHELL NUCLEI
Lorenz Anthony Kull (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-4166

The energy levels of ^{5}Li, ^{6}Li, ^{8}Be, ^{9}B and ^{10}B excited in the (p,d) reaction have been studied with a 33.6 MeV incident proton beam from the isochronous cyclotron. The differential cross sections were measured for the strongly excited levels using a solid state dE/dx counter telescope to detect the deuterons. The angular distributions were also measured for the elastic scattering of 33.6 MeV protons from ^{6}Li, ^{7}Li, ^{9}Be and ^{10}B. Optical model fits were made with a computer code to this elastic proton data and to deuteron elastic scattering data obtained from the literature in order to extract optical parameters. These optical model parameters were used in a computer code which performed distorted wave Born approximation (DWBS) calculations for the (p,d) reactions. The DWBA results were subsequently used to extract spectroscopic factors for all the strongly excited levels of the nuclei being studied. Dissert. Abstr.

N68-37667 Minnesota Univ., Minneapolis.
INELASTIC SCATTERING OF 40 MeV POLARIZED PROTONS
Martin Paul Fricke (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-1613

The left-right asymmetry and differential cross section for the inelastic scattering of 40 MeV polarized protons were measured over a large angular region for each of the following 2+ excitations: 1.78 MeV in ^{28}Si, 1.41 and 2.97 MeV in ^{54}Fe, 1.45 MeV in ^{58}Ni, and 1.33 MeV in ^{60}Ni. Some asymmetry and cross-section data were also obtained for 3− states: 6.9 MeV in ^{28}Si, 4.8 and 6.4 MeV in ^{54}Fe, 4.5 MeV in ^{58}Ni, and 4.08 MeV in ^{60}Ni. Elastic polarization and cross-section data were obtained for each target. The inelastic scattering was analyzed in distorted wave approximation using the collective model extension of the optical model potential determined by fitting the elastic scattering. The inelastic asymmetry and cross section data are best reproduced with a collective model interaction obtained by deforming the complete optical potential, including its imaginary and spin-orbit parts. Dissert. Abstr.

N68-37671# Argonne National Lab., Ill.
TRANSMISSION OF FAST ELECTRONS THROUGH THICK LAYERS OF MATTER [DURCHGANG SCHNELLER ELEKTRONEN DURCH DICKE MATERIESCHICHTEN]
Dietrich Harder 1967 148 p refs Transl. into ENGLISH from German Thesis
(ANL-TRANS-608) CSFTI: HC $3.00/MF $0.65

The experimental and theoretical programs are reviewed. The details of the experimental assemblies are presented as briefly as possible, since they can be found in other papers. The theoretical part deals with an evaluation of the diffusion model and with the Monte Carlo method. Details concerning the corresponding calculation program are found in the appendix. NSA

N68-37673# Uppsala Univ. (Sweden). Inst. of Physics.
A DIRECTIONAL CORRELATION STUDY OF INTERBAND TRANSITIONS IN ^{172}Yb
R. Vulkanovic, M. Zupancic, H. A. Lindstroem and L. Samuelsson Apr. 1968 34 p 40 refs
(UUIP-577)

The $\Delta K=3$ transitions de-exciting the K=3 rotational band based on the 1172-keV state in ^{172}Yb were studied by γ-e$^-$ and e$^-$-e$^-$ directional correlations. The E2/M1 mixing ratios for the 912-, 1003-, 1093-, and 115-keV transitions were determined and were compared with theoretical predictions. The conversion coefficient of the 912-keV transition was obtained as well as the total K particle parameters for the 912- and 1093-keV transitions. The half-life of the 1172-keV state was found to be $T_{1/2}$=7.95 nsec. Author (NSA)

N68-37690# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DYNAMICAL MOMENTS OF CURRENTS OF COMPOSITE PARTICLES IN QUANTUM FIELD THEORY
V. A. Matveev 1968 22 p 6 refs In RUSSIAN
(JINR-P2-3847)

The problem of finding the local currents of the composite particles is considered in the framework of the relativistically covariant quantum mechanical description. Author (NSA)

N68-37694# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INVESTIGATION OF ELECTRON-PHOTON SHOWERS INDUCED BY γ-QUANTA AT 100, 200, 500, AND 2000 MeV IN LIQUID XENON
B. Slovinskii, Z. S. Strugal'skii, and B. Yanovskaya 1968 19 p 11 refs In RUSSIAN
(JINR-P1-3919)

The electron-photon showers, produced by γ quanta in liquid xenon at E_γ = 100, 200 500, and 2000 MeV, are being investigated. The experimental data concerning the fluctuations in the development of these showers were obtained. Author (NSA)

N68-37700# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
COMPARISON OF THE LIFE-TIMES OF THE CHARGED PIONS

V. I. Petrukhin, V. I. Rykalin, D. M. Khazins, and Z. Tsisek 1968 22 p 7 refs In RUSSIAN
(JINR-P1-3862)

The lifetimes of the charged pions are compared in order to check the CPT-theorem. The experiment is based on the comparison of the attenuation of π^+ and π^--meson beams (having the momentum p = 180 MeV/c) which is due to their decay in flight. The maximum change of the path length is equal to 6.84m, which corresponds to 0.683 of the π-meson decay length with the above momentum. The identification of the π-mesons and the measurement of their velocities were performed with the aid of a time-of-flight spectrometer having a time resolution of $2\tau = 0.65$ nsec. The value of the difference of the charged pion lifetimes is found to be $\tau_+/\tau_- - 1 = (-0.14 \pm 0.29)\%$. Author (NSA)

N68-37701# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELECTROMAGNETIC MASS DIFFERENCE OF Ξ HYPERONS
V. S. Dorodnykh and B. V. Struminskii 1968 7 p 3 refs In RUSSIAN
(JINR-P2-3928)

The electromagnetic mass difference of Ξ hyperons was calculated by using the sum rules for a finite energy of a virtual Compton effect. The results agree well with the experimental data. Author (NSA)

N68-37702# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE HIGH-ENERGY BEHAVIOUR OF THE DIFFERENTIAL CROSS-SECTION OF CERTAIN INELASTIC PROCESSES INVOLVING LEPTONS
Varuzhan Baluni 1968 13 p 10 refs In RUSSIAN
(JINR-P2-3856)

The analyticity of the differential cross section of certain electromagnetic and weak inelastic processes with momentum transfer is proved in a fairly large domain. Some bounds on the behavior of the differential cross section are derived. Author (NSA)

N68-37703# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SPECTRAL REPRESENTATION OF THE TWO-POINT FUNCTION FOR INFINITE-COMPONENT FIELDS
I. T. Todorov and R. P. Zaikov 1968 13 p 9 refs
(JINR-E2-3891)

The general form of a Lorentz invariant two point function is written down in momentum space as an expansion in terms of eigenfunctions of the total spin. It leads naturally to a local expression for finite component fields, but incorporates nonlocal infinite component fields. Explicit examples of such fields with increasing mass spectrum are constructed. Author (NSA)

N68-37704# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ELECTRON-CAPTURE DECAY OF Po-204
V. Kush and I. I. Chuburkova 1968 20 p 15 refs Submitted for publication
(JINR-E7-3868)

The gamma-ray spectrum from the electron-capture decay of ^{204}Po was investigated with the germanium detector, and the tentative energy levels scheme of ^{204}Bi was discussed. Author (NSA)

N68-37705# Uppsala Univ. (Sweden). Inst. for Physics.
THE EFFECT OF NUCLEAR MAGNETIC RESONANCE ON ANGULAR CORRELATIONS AND DISTRIBUTIONS
B. A. Olsen, E. Matthias (Calif. Univ., Berkeley) AND R. M. Steffen (Purdue Univ.) Apr. 1968 51 p
(UUIP-538)

The theory is developed for radiative detection of NMR isomeric nuclear states by use of gamma-ray angular correlations and distributions. It is illustrated with numerical examples. The use of multiple radiation fields for detection introduces new and hitherto unobserved line shapes. For rf with random phase, the resonance line is k-fold split, where k is the summation index of the Legendre polynomial expansion. If pulsed rf with a constant phase is used, the form and symmetry of the resonances depend strongly upon the phase and the geometry of the experiment. Using linearly polarized rf with a fixed phase offers, at certain geometries, the possibility of obtaining the relative sign of gH with respect to a reference case. The existence of a "hard core" value at resonance frequency is demonstrated. Various geometries are examined with respect to their applicability in angular correlation or nuclear reaction experiments. Time-differential perturbation factors are discussed and are found to be valuable for a detailed understanding of the resonance effects. Author (NSA)

N68-37706# Radiation Research Associates, Inc., Fort Worth, Tex.
GRASS: A MONTE CARLO PROCEDURE FOR CALCULATING GAMMA-RAY ATTENUATION OF SIMPLE STRUCTURES
J. H. Price 1 Dec. 1967 55 p 4 refs
(Contract N00228-67-C-2019)
(RRA-T79; USNRDL-TRC-68-10; AD-672022)

The GRASS Monte Carlo procedure was written in 1130 FORTRAN to calculate gamma-ray attenuation in simple cylindrical structures. GRASS calculates the structure-scattered gamma-ray flux energy distribution and exposure angle distribution at a point on the centerline of an upright cylindrical barrier exposed to gamma rays from a plane source located on, or near, the ground surface. The energy and angle distribution of the flux incident upon the structure is calculated by a related Monte Carlo procedure and is input in a fixed form which describes (1) uncollided gamma rays which reach the barrier before having a collision in the air or ground and (2) scattered gamma rays incident on the barrier after having at least one collision in the air or ground. GRASS employs a pseudo source based on probability distributions derived from the incident flux distributions. The source is located on the outer lateral surface of the barrier. The intensity of the pseudo source representing the uncollided incident flux may be varied in up to 3 steps, as a function of height along with barrier wall, while the pseudo source used to describe the scattered incident flux is assumed to have the same intensity at all heights. Much of the versatility found in larger Monte Carlo procedures was sacrificed for speed and compactness, allowing GRASS to be compatible with the storage available in the IBM 1130 computer and perform gamma-ray scattering calculations in cylindrical barriers with greater efficiency. Author (TAB)

N68-37708*# Ling-Temco-Vought, Inc., Dallas, Tex. Nuclear Science Group.
INVESTIGATION OF ELECTRON INTERACTION IN MATTER Final Report, 9 Feb. 1967–9 Feb. 1968
Washington NASA Oct. 1968 338 p 14 refs
(Contract NAS8-21055)
(NASA-CR-1194; Rept.-0-7100/8R-2) CFSTI: HC $3.00/MF $0.65 CSCL 20H

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N68-37709*# Ling-Temco-Vought, Inc., Dallas, Tex. Nuclear Science Group.

MEASUREMENT OF ELECTRON SCATTERING IN ALUMINUM AT 1.0 MeV FOR NON-NORMAL INCIDENCE

David H. Rester and Walter J. Rainwater, Jr. *In its* Invest. of Electron Interaction in Matter Oct. 1968 p 3-241 4 refs (See N68-37708 24-24)

Scattered electrons due to a beam directed to a plane target with non-normal incidence were investigated to predict the results for an ominidirectional electron flux in space. The beam was directed to 0.22 g/cm^2 Al target at an incident angle of 60°, and 212 spectra were mapped at grid points in three dimensions above the plane defined by the incident beam and the target normal at the beam-target intercept. Angular distributions due to scattered electrons are given in two forms. Energy distributions shown are characteristic of the different shapes the distributions exhibited in various regions relative to the target, and a complete catalog of energy distributions is included. M.W.R.

N68-37710*# Ling-Temco-Vought, Inc., Dallas, Tex. Nuclear Science Group.

ELECTRON-BREMSSTRAHLUNG CROSS SECTION MEASUREMENTS AT INCIDENT ELECTRON ENERGIES OF 0.2, 1.0, 1.7, AND 2.5 MeV

David H. Rester and William E. Dance *In its* Invest. of Electron Interaction in Matter Oct. 1968 p 243-282 4 refs (See N68-37708 24-24)

Measurements were made at 0.2, 1.0, 1.7, and 2.5 MeV incident electron energies to explore the apparent transition region between 1.0 and 2.72 MeV in which electron-bremsstrahlung cross sections vary from theoretical predictions. Cross sections are reported for thin targets of Al, Au, Cu, and Sn; data are plotted along with corresponding values obtained by the Born approximation; and the present experimental values are compared with some previously obtained data. Bremsstrahlung cross sections were different only when derived from the values at the various angles by integration over solid angle. The limiting value of the integrated cross sections at high energy point permits thick target bremsstrahlung yield computations to be adjusted in a relatively simple manner to conform with the measured cross section values. M.W.R.

N68-37711# Ling-Temco-Vought, Inc., Dallas, Tex. Nuclear Science Group.

ELECTRON-BREMSSTRAHLUNG PRODUCED IN THICK TARGETS AT INCIDENT ELECTRON ENERGIES OF 0.2, 1.0, 2.0, AND 2.8 MeV

William E. Dance and David H. Rester *In its* Invest. of Electron Interaction in Matter Oct. 1968 p 284-330 6 refs (See N68-37708 24-24)

Measurements were made on Be, Al, Fe, Sn, and Au at incident energies of 0.2, 1.0, and 2.0 MeV, and on Al, Fe, Sn, and Au at 2.8 MeV. Intensities were measured at photon emission angles ranging from 0 to 150° to the incident beam direction. Targets were of sufficient thickness to stop the electrons. Experimental spectral distributions of bremsstrahlung distributions are presented, with no corrections for photon attenuation in the target material included. Intensity spectra at 0.2 MeV exhibit increasing hardness with atomic number Z for all photon angles, and spectral hardening is also seen in going from the backward direction to the forward angles. Photon attenuation in the target increased with atomic number. Forward peaking with increasing bombarding energy of the intensity per unit solid angle is indicated by the angular distributions. M.W.R.

N68-37717 Brandeis Univ., Waltham, Mass.

A SEARCH FOR C NONCONSERVATION IN ELECTRON POSITRON ANNIHILATION

Allen Paine Mills, Jr. (Ph.D. Thesis) 1967 181 p

Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-16568

A search for charge conjugation (C) noninvariant three photon annihilations of $^1S_0$ electron-positron states is described. The experiment was designed to separate the C-forbidden 3γ decay of $^1S_0$ from the C-allowed 3γ decay of $^3S_1$ states by studying the angular distribution of the three photons. The 3γ rate at the symmetric configuration and at two other sets of angles, were studied. Metric to symmetric counting rates will change when the relative abundance of triplet to singlet annihilations is changed by NO quenching, if and only if there is some C-nonconserving contribution from the $^1S_0$ annihilations. Using a phenomenological point interaction, we have obtained as an upper limit with 68% confidence that less than 4×10^{-6} of all $^1S_0$ decays proceed via the C-forbidden mode $^1S_0 \rightarrow 3\gamma$. A complete description of the experimental apparatus and the details concerning background effects and systematic errors are given. Dissert. Abstr.

N68-37778# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

SPECTROMETER FOR INELASTIC SCATTERING OF THE THERMAL NEUTRONS STUDIES AT THE PULSED IBR REACTOR

Jerzy Sosnowski, Izabela Sosnowska and Edward Maliszewski 1968 19 p 20 refs Presented at Symp. on Inelastic Neutron Scattering, Copenhagen, 20-24 May 1968

(INR-P-898/II/PS; SM-104/131)

The design of a spectrometer for studies of inelastic coherent scattering of thermal neutrons by single crystals at the IBR reactor is described. A polychromatic pulse neutron beam is scattered by a single crystal sample and the energy of scattered neutrons is analyzed by three analyzing single crystals for three different beams of scattered neutrons. The time of flight technique is used to measure the incident neutron energy. The spectrometer is adapted for simultaneous structure and lattice dynamics studies of solids. Special features of this spectrometer and its applications are discussed. Author (NSA)

N68-37779# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

LOW ENERGY PART OF THE α PARTICLE SPECTRUM FROM TRIPARTITION OF U-235

J. Chwaszczewska, M. Dakowski, T. Krogulski, E. Piasecki and J. Tys 1968 7 p 6 refs

(INR-P-911)

Measurement of the low-energy part of the spectrum of α particles emitted in thermal neutron fission of ^{235}U was performed with a telescope counter. The upper limit for the cross section of the $^{235}U(n,\alpha)\ ^{232}Th$ reaction was estimated to be 3 mb for the transition to the ground state and 2 mb for the transition to the excited state up to 5 MeV. Author (NSA)

N68-37780# California Inst. of Tech., Pasadena.

MESON CLASSIFICATION IN THE QUARK MODEL

George Zweig Apr. 1968 14 p refs Presented at the Conf. on Exptl. Meson Spectry., Philadelphia

(Contract AT(11-1)-68)

(CALT-68-162; CONF-680428-8) CFSTI: HC $3.00/MF $0.65

The current status of the quark model for classification of lowlying meson states is examined. The discussion covers the questions of whether a harmonic oscillator potential or, more generally, the quantum number n is needed; that is, whether there are any radial vibrations; also whether all quark spin singles (S=0) objects fall into octets plus singlets with a (mass)^2 structure similar

to the pseudoscalar mesons, whether triplet states (S = 1) always form nonets with a (mass)^2 structure like the vector mesons; the variation of the S-S interactions with (n,L); and the variation of the L-S interaction with (n,L) are considered. NSA

N68-37781 European Organization for Nuclear Research, Geneva (Switzerland).
TOPICS ON REGGE-POLE THEORY OF HIGH-ENERGY SCATTERING
L. van Hove 25 Jul. 1968 80 p 37 refs Presented at the Acad. Training Programme of CERN, Geneva, 1967–1968
(CERN-68-31)

Discussed are the basic features of the Regge pole theory and its application in the following aspects of high energy interactions: (1) two-body collisions and particle exchanges; (2) S-matrix analysis in momentum transfer; and (3) diffraction and absorption property corrections. The present model displays difficulties if it is applied to experimental data that contain non-vanishing spins and unequal masses of the external particles. G.G.

N68-37789# Purdue Univ., Lafayette, Ind.
THE REACTION $K^-d \rightarrow K^{*-}(890)d$ AT 4.5 GeV/c
R. L. Eisner, A. C. Ammann, D. D. Carmony, A. F. Garfinkel, L. J. Gutay et al. Jul. 1968 10 p Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(Contract AT(11-1)-1428)
(COO-1428-82; CONF-680809-4) CFSTI: HC $3.00/MF $0.65

The ω-exchange contribution to $K^{*-}(890)$ production off deuterium at an incident K^- momentum of 4.5 GeV/c is discussed. The reaction $K^- + d \rightarrow K^0 + \pi^- + d$ is studied in 68 events found in a deuterium bubble chamber. The $K^0\pi^-$ effective mass spectrum is shown. NSA

N68-37815# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
THE SANITA SUBGROUP OF THE INFN [REALAZIONE SULL'ATTIVITA DELLA SOTTOSEZIONE SANITA DELL'INFN NEL 1967] Annual Progress Report, 1967
11 Dec. 1967 21 p 26 refs In ITALIAN; ENGLISH summary
(ISS-67/44)

The activities of the "Sottosezione Sanita" of the INFN during the year 1967 are outlined. Research in the fields of elementary particle physics, nuclear physics, solid-state physics, and electromagnetic interactions is described. A brief account of the activities of the theoretical group and of the computing center is also given. Author (NSA)

N68-37835# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
BEHAVIOR OF THE DIFFRACTION PEAK FOR PARTICLES WITH ARBITRARY SPINS
Nguyen thi Hong 1968 16 p 9 refs In RUSSIAN
(JINR-P2-3896)

It is shown that the lower bound for the width of the diffraction peak at $s \rightarrow \infty$ $\Delta \geq (\text{const}/\ln^2 s)$, obtained by Logunov et al. for spinless particles holds also for particles with arbitrary spins. Author (NSA)

N68-37847# Kogakuin Univ., Tokyo (Japan). Faculty of Liberal Arts.
EFFECTS OF RESCATTERING ON THE REACTION LITHIUM 6 (NEGATIVE PION, 2N) HELIUM 4
Il-Tong Cheon Jun. 1968 21 p 15 refs
(KG-1) CFSTI: HC $3.00/MF $0.65

The rescattering effects on the reaction $^6Li(\pi^-,2n)^4He$ are investigated on the basis of previous theory by which absorption of pions at low energy by a deuteron is treated. The wave function of ^6Li is given by the α-deuteron cluster model including the nuclear correlations due to the short-range repulsive core of the nuclear force. The rescattering gives large effects to the total absorption rates and the momentum distributions of the emitted neutrons. In particular, the rescattering makes a strong interference with the nuclear correlation in the strength of $\eta = 1.6 fm^{-2}$. The theoretical curves give good agreements with the experimental data. Author

N68-37848# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
DETERMINATION OF STATISTICAL PARAMETERS OF THE DOUBLE-TRIPLE COINCIDENCE CIRCUIT
J. Kalisz 1968 15 p 3 refs In POLISH
(INR-904)

A triple coincidence circuit is considered, which consists of two double coincidence circuits connected in series. The probability density of registration time of the first double coincidence circuit and the coincidence curve of the whole triple coincidence circuit are determined analytically. Two methods are presented for determination of statistical parameters of the double-triple coincidence circuit on the basis of the empirical coincidence curve. Author (NSA)

N68-37856*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUPRATHERMAL PROTON X-RAY BREMSSTRAHLUNG
Elihu Boldt and Peter Serlemitsos Oct. 1968 15 p 21 refs
(NASA-TM-X-63378; X-611-68-385) CFSTI: HC $3.00/MF $0.65
CSCL 20H

Copious X-ray production is shown to attend the collisions of suprathermal ($\geq$MeV) protons with ambient electrons, via a process of inverse bremsstrahlung. Such suprathermal protons have been detected in cosmic rays and in solar flare events; the inverse bremsstrahlung of such cosmic ray protons is expected to make a significant contribution to the diffuse sky background of X-rays and suprathermal solar protons to the X-ray bursts associated with solar flares. The X-ray production in the supernova remnant Tau A (Crab Nebula) is too high to be readily accounted for by the inverse bremsstrahlung of suprathermal protons. Author

N68-37860# Brookhaven National Lab., Upton, N. Y.
PULCAL: A COMPUTER PROGRAM TO OBTAIN PEAK ENERGIES FROM CHANNEL NUMBERS WHEN A PRECISION PULSER HAS BEEN EMPLOYED TO CORRECT FOR NONLINEARITY
M. A. J. Mariscotti 20 Jun. 1968 13 p
(BNL-12622) CFSTI: HC $3.00/MF $0.65

A computer program is described which finds the number of pulser peaks, finds the number of gamma-ray peaks, finds the pulser peaks flanking each gamma ray peak, computes the position of gamma-ray peaks and pulser peaks, and then computes the energies of the gamma-ray peaks. NSA

N68-37862# Hungarian Academy of Sciences, Budapest. Kozponti Fizikai Kutato Intezete.
CODE FOR CALCULATION CONCERNING NEUTRON MOISTURE MEASUREMENTS
P. Vertes and A. Z. Nagy 12 Jun. 1968 8 p 5 refs
(KFKI-15/1968)

A short description of a code, written in 1CT-algol, for calculating the number of detected neutrons originated from a point source and slowed-down in an infinite homogeneous mixture of any dry material and water, is given. The required input information, the possible outputs and the listing are also presented. Author (NSA)

N68-37864# Purdue Univ., Lafayette, Ind. Dept. of Physics.
POLARIZATION OF THE Λ HYPERON FOR THE REACTION $K^- n \rightarrow \pi^- \Lambda$ AT 4.5 GeV/c
W. L. Yen, A. C. Ammann, D. D. Carmony, R. L. Eisner, A. F. Garfinkel et al Jul. 1968 6 p refs Presented at Intern. Conf. on High Energy Phys., Vienna
(Contract AT(11-1)-1428)
(COO-1428-81; CONF-680809-7) CFSTI: HC $3.00/MF $0.65

A preliminary study of the Λ polarization in the reaction $K^- + n \rightarrow \pi^- + \Lambda$ is presented, and the result is compared with a recent double Regge pole prediction. A deuterium bubble chamber was exposed to a 4.5 GeV/c K^- beam. The partial cross section, momentum transfer distribution, as well as the polarization of the hyperon (Λ) were determined. NSA

N68-37872# Purdue Univ., Lafayette, Ind.
TWO PRONG INTERACTIONS IN NEGATIVE PION PROTON AT 2.7, 4.2, AND 5.0 GeV/c
D. Carmony, R. Eisner, L. Gutay, W. Yen, R. Peters et al Jul. 1968 17 p 5 refs Presented at 14th Intern. Conf. of High Energy Phys., Vienna
(Contract AT(11-1)-1428)
(COO-1428-71; CONF-680809-3) CFSTI: HC $3.00/MF $0.65

Results from a study of two-prong final states from a 150,000 picture π^- + p run at 5.0 GeV/c in a bubble chamber are presented. Production cross sections and meson resonance cross sections for the two-prong final states are given, and histograms of the $\pi\pi$ effective mass for the reactions $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ and $\pi^- + \pi^+ + n$, respectively. The structure of the f^0, the A_2 splitting, and various N^* resonances are studied. Also the A_2 and $A_{1.5}$ resonances are found in the reaction $\pi^- + p \rightarrow \pi^- + p +$ MM, where MM is the mass of unobserved neutral particles. NSA

N68-37879# Argonne National Lab., Ill.
RELATIVE PROBABILITIES OF THE EXCITATION OF ISOMERIC STATES DURING RADIATION CAPTURE OF THERMAL NEUTRONS
A. V. Malyshev Jun. 1968 10 p 11 refs Transl. into ENGLISH of Gos. Kom. po Ispol'z. At. Energ. SSSR, Obninsk Rept. FEI-79
(ANL-TRANS-644) CFSTI: HC $3.00/MF $0.65

The relative probabilities of the formation of isomeric states during the radiative capture of thermal neutrons were calculated on the basis of the statistical theory. The calculations were carried out by a method which considers the distribution of the γ sources in every cascade with the purpose of verification of the dependence of the density of nuclear levels on the total angular momentum. It is shown on the example of 8 odd-odd nuclei for which the isomer ratios differ by ≈30 times that if a single theoretical parameter is assigned, namely the density of one-particle states near the Fermi energy, then the agreement with experiment is obtained within the limits of 50%. Author (NSA)

N68-37881# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
UNITARY SYMMETRY THEORY OF MULTIPLE PARTICLE PRODUCTION
V. S. Bardshenkov and G. M. Zinov'ev 1968 33 p 22 refs In RUSSIAN
(JINR-P2-3879)

A statistical model was suggested in which the particles are considered as terms of SU_3-multiplets and the transitions are possible only between the states which correspond to the same irreducible representations of the SU_3 group. The $p-\bar{p}$ and $\bar{p}-n$ annihilations at rest and inelastic π^+p interactions in the energy range T>1 GeV are considered in detail. Author (NSA)

N68-37885# Case Western Reserve Univ., Cleveland, Ohio.
A RESEARCH PROGRAM IN HIGH-ENERGY ACCELERATOR PHYSICS AND LOW-LEVEL COUNTING ELEMENTARY PARTICLE PHYSICS Technical Report, 1 Oct. 1967–30 Sep. 1968
T. L. Jenkins Jun. 1968 12 p 5 refs
(Contract AT(11-1)-1749)
(COO-1749-5) CFSTI: HC $3.00/MF $0.65

Research on high-energy physics experiments is briefly discussed, including the neutrino and low-level counting work, a search for double beta decay in ^{150}Nd, and an experiment to set a limit on the lifetime of the proton. Preparations are made for a series of experiments studying the charge exchange reaction $\pi^- + p \rightarrow \pi^0 + n$ at various energies, and analysis is started on the inelastic scattering of 12-GeV muons from carbon and hydrogen, and the search for a CP violating contribution in the decay mode $K^0_2 \rightarrow \pi^+ + \pi^- + \pi^0$. For the last experiment preliminary results are given. NSA

N68-37886# Brookhaven National Lab., Upton, N. Y.
DIRECT AND INVERSE PHOTONUCLEAR REACTIONS ON N^{15} AND O^{15} NUCLEI
M. A. Zhusupov and R. A. Eramzhyan 1968 20 p 18 refs Transl. into ENGLISH from the Report JINR-P4-3874
(BNL-TR-218) CFSTI: HC $3.00/MF $0.65

Direct and inverse photonuclear reactions on ^{15}N and ^{15}O mirror nuclei are considered in terms of a particle-hole approach with due regard for the pairing correlations of nucleons in the nucleus. A wide peak of the dipole transitions (in the energy range of 20 to 21 and 25 to 26 MeV), as well as a "pigmy resonance" in the energy range of 20 MeV, is given. The isospin structure of the resonance is studied. The "pigmy resonance" is due to the excitation of the states with T=1/2, while the main peak is due to the states with T=3/2. The decay mode of the dipole states of the ^{15}N nucleus is calculated. It is shown that the contribution of the three-particle decay channel is rather large. The inverse $^{14}N(p,\gamma)$ ^{15}O and $^{14}C(p,\gamma)^{15}N$ reactions emitting γ-quanta to the ground and excited state $J=3/2^-$ of the ^{15}N and ^{15}O nuclei are investigated. The resonances have different structure in these mirror nuclei. Author (NSA)

N68-37899# Brookhaven National Lab., Upton, N. Y.
COHERENT PRODUCTION OF THE PROTON POSITIVE AND NEGATIVE PION ENHANCEMENT AT 1470 MeV BY 28-GeV/c PROTONS ON NEON
F. R. Huson, D. J. Miller and J. S. O'Neall 5 Aug. 1968 19 p 13 refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna, 28 Aug.–5 Sep. 1968
(BNL-12674; CONF-680809-11) CFSTI: HC $3.00/MF $0.65

In a 28-GeV/c proton exposure of a neon-hydrogen bubble chamber, coherent production of $p\pi^+\pi^-$ was observed. The "1470" enhancement seen in pp experiments dominates the coherent channel. A comparison of its cross section on neon with pp results at 28.5 GeV, using a nuclear absorption model, shows that the total cross section for the $p\pi^+\pi^-$ final state on nucleons is greater than 70 mb, which makes it unlikely that the 1470 is a resonance. Its production and decay angular distributions indicate appreciable parity mixing. Author (NSA)

N68-37903# Purdue Univ., Lafayette, Ind.
STRANGE PARTICLES IN π^-p INTERACTIONS AT 5.0 GeV/c
P. J. Weisbach, C. G. Howard, T. R. Palfrey and R. J. Sahni Jul. 1968 25 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(Contract AT(11-1)-1428)
(COO-1428-72; CONF-680809-6) CFSTI: HC $3.00/MF $0.65

The analysis of strange particle events obtained from a 150,000 picture exposure to a 5.0 GeV/c π^- beam in a hydrogen

bubble chamber is reported. The YK enhancements are seen in both the $\Delta K^+\pi^-$ and $\Sigma^-K^+\eta^0$ final states. The ΔK^+ enhancement, generally attributed to the $N(1688)$, is consistent with previous data. But the Σ^-K^+ enhancement favors the production of a low angular momentum resonance which decays into ΣK. Two $\Sigma K\pi$ peaks are observed in the five-body final states at masses of 2.19 and 2.42 GeV. The possible interpretation of these peaks as production of the $N(2190)$ and $\Delta(2420)$ was suggested. NSA

N68-37915# Los Alamos Scientific Lab., N. Mex.
THE EFFECT OF THE EXCITATION ENERGY OF A FISSIONABLE NUCLEUS OF U-239 ON THE YIELD AND KINETIC ENERGIES OF FRAGMENTS
V. G. Vorob'eva et al Jul. 1968 16 p 11 refs Transl. into ENGLISH from Russian Rept. FEI-108
(LA-TR-68-21) CFSTI: HC$3.00/MF$0.65

The distribution of fragments in mass and kinetic energies in the fission of ^{238}U induced by neutrons with energies of 1.4, 1.6, 1.9, 5.0, 5.5, and 6.9 MeV are investigated. The results of the measurements are analyzed in the framework of a statistical model. A correlation of the fission-yield fine structure is discussed with a dependence curve of maximum fission energy on the mode of fission. It is found that the mean kinetic energy of fragments practically does not depend on the energy of neutrons which induce a fission. Author (NSA)

N68-37934# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Nuclear and Radiation Physics Section.
INTRODUCTION TO THE THEORY OF DIRECT NUCLEAR REACTIONS
J. Dooher Sep. 1968 60 p
(RE-343) CFSTI: HC$3.00/MF$0.65

Nonrelativistic scattering theory is reviewed and applied to the problem of deuteron stripping and pickup reactions as an introduction to the theory of direct nuclear reactions. Formal scattering theory is stressed so that the theory of direct nuclear reactions may be presented in a unified manner. Author

N68-37938# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
KINETICS OF TWO MULTIPLE LOOSELY COUPLED SYSTEMS: THEORY AND EXPERIENCE [CINETICA DI DUE SISTEMI MOLTIPLICANTI DEBOLMENTE ACCOPPIATI: TEORIA ED ESPERIENZE]
U. Farinelli and N. Pacilio 1968 58 p refs In ITALIAN; ENGLISH summary
(RT/FI(68)27) CFSTI: HC$3.00/MF$0.65

Pulsed measurements were made in two organic moderated and reflected loosely coupled cores in order to analyze their kinetic and reactive behavior. Under the hypothesis of loose coupling, the time analysis of the pulse response of the reactor gives separate information on the component core reactivity, on the coupling amount, and on the neutron lifetime. In fact, observables exist which are strictly correlated to these quantities: they characterize the neutron decay in any point of the system. Author

N68-37939# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
NEUTRON RESONANCES OF THE GADOLINIUM ISOTOPES
E. N. Karzhavina, Nguyen Nguyen Phong, and A. B. Popov 1968 31 p refs In RUSSIAN
(JINR-P3-3882)

The transmission and yield of γ rays from the neutron capture for ^{152}Gd, ^{154}Gd, ^{155}Gd, ^{156}Gd, ^{157}Gd, ^{158}Gd, ^{160}Gd isotopes were measured with the help of a neutron spectrometer of the Neutron Physics Laboratory of the JINR. The parameters of the neutron resonances were determined, and some average characteristics of the Gd isotope nuclei were calculated. Author (NSA)

N68-37948# Argonne National Lab., Ill.
ELECTROMAGNETIC RENORMALIZATION OF THE VECTOR PART OF THE $\nu_e e$ INTERACTION [ELEKTROMAGNITNAYA PERENORMIROVKA VEKTORNOI CHASTI $\nu_e e$ VZAIMODEISTVIYA]
V. N. Folomeshkin 1967 7 p refs Transl. into ENGLISH from the Russian Report IFVE-STF-67-60-K
(ANL-TRANS-643) CFSTI: HC$3.00/MF$0.65

The electromagnetic renormalization of the vector part of the $(\nu_e e)$ $(\nu_e e)$-interaction is considered in the first order weak interaction and account is taken of all the orders of electromagnetic interaction. It is shown that this renormalization is finite. The numeral value of the renormalization constant Z^W depends on the total hadron contribution to the vacuum polarization. In any case it holds for the inequalities $1/2 \leq Z^W \leq 1$. Author (NSA)

N68-37953# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ACCOUNT OF INTERMEDIATE EXCITATIONS IN THE DEUTERON STRIPPING REACTIONS
O. Dumitrescu, V. K. Luk'yanov, and I. Zh. Petkov 1968 18 p refs in RUSSIAN
(JINR-P4-3872)

An expression was obtained for the deuteron stripping cross section on deformed nuclei. Therefore, the intermediate rotational and nonrotational states were taken into account. The result is illustrated in perturbation theory on residual interactions. Spectroscopic amplitudes of the intermediate transitions are calculated in the microscopic nuclear model. Author (NSA)

N68-37958# Cekmece Nuclear Research Center, Istanbul (Turkey).
STRAIGHTFORWARD PERFORMANCE OF RESOLUTION CORRECTION
Cetin Cansoy and Yilmaz Oergeevren Apr. 1968 32 p refs
(CNAEM-51)

Two different new methods have been developed for the resolution correction of neutron resonance measurements instead of trial-and-error method. These methods have been applied on the experimental results of the second neutron resonance in ^{149}Sm and of the first neutron resonance in ^{169}Tm as examples. Author (NSA)

N68-37967# Tokyo Univ. (Japan). Dept. of Physics.
SPECTRAL FUNCTION OF THE PHOTON PROPAGATOR MASS SPECTRUM AND TIME-LIKE FORM FACTORS OF PARTICLES
Hidezumi Terazawa Sep. 1968 31 p refs
CFSTI: HC$3.00/MF$0.65

Contributions to the spectral function of the photon propagator from the states which contain a particle (mass m_J) of arbitrary spin J and its antiparticle are considered. The contributions are expressed in terms of time-like form factors. The unitarity limit of the spectral function can be transformed into the asymptotically bounded condition. The experimental information about the anomalous magnetic moment of the muon gives the restriction on the sum of all the contributions. Using the restriction, examinations are made of the various mass spectra of particles. Author

N68-37973# Gruman Aircraft Engineering Corp., Bethpage, N. Y. Nuclear and Radiation Physics Section.
AN OPTICAL MODEL COMPUTATION TECHNIQUE FOR NEUTRON AND PROTON SCATTERING IN THE MeV REGION

F. R. Swanson, M. L. Rossi and A. J. Favale Sep. 1968 65 p refs
(RE-344) CFSTI: HC $3.00/MF $0.65

To implement the nuclear cross section program on the Van de Graaff accelerator for shielding applications, a computer program has been developed for the evaluation of elastic scattering cross sections. The numerical output of this program is expected to serve as a guide for associated experimental studies, particularly in regions of particle energy and scattering angles that are not directly accessible to laboratory measurement. Nuclear scattering of incident neutrons or protons is treated here by including a complex potential in the Schrödinger equation and performing a partial wave expansion over orders of angular momentum (Rayleigh expansion). The radial wave functions are then evaluated by a central-difference integration scheme, using approximately 400 mesh points on the 1130 computer, and are finally matched to appropriate asymptotic solutions beyond the radial range of the optical potential. Spin-orbit coupling during the scattering is considered, for spin 1/2 incident particles, while Coulomb effects for proton interactions are handled by a program option. Numerical results of the machine computation yield the (coherent) differential elastic cross section, the reaction cross section, and, for neutrons, the total interaction cross section.
Author

N68-37974# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
LOW THEOREM FOR THE OBSERVABLES
A. V. Tarasov 1968 13 p refs In RUSSIAN
(JINR-P2-3851)

The components of polarization tensors of any process, accompanied by the soft photon emission, are determined in the Low approximation only by the components of an analogous polarization tensor of a corresponding process without the photon emission.
Author (NSA)

N68-37989 Iowa State Univ. of Science and Technology, Ames.
THE ns SQUARED S 1 STATES OF THE HELIUM ATOM
Robert Brent Stevenson (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-16846

The first five members of the $(ns)^2$ ^1S series of the helium atom are investigated by several theoretical methods. Within the closed-shell approximation, hydrogenic functions constrained by the O'Malley–Geltman procedure are compared to unconstrained hydrogenic functions. A single term trial function satisfying the O'Malley–Geltman constraint approaches the He+ solution as n increases, and there is no effective nuclear screening for the $4s^2$ and higher states. Furthermore, the virial theorem is not satisfied. Closed shell unconstrained numerical self consistent field, S.C.F., wave functions are found to satisfy the virial theorem, and correspond to eigenvalues that lie consistently below those for the projected hydrogenic functions. A numerical constrained S.C.F. wave function is proposed as the solution to an inhomogeneous integro–differential eigenvalue equation. The analyticity of the $(ns)^2$ states of the helium atom and the $1s^2$ isoelectronic series is investigated by examining the radius of convergence of numerical S.C.F. solutions.
Dissert. Abstr.

N68-38002# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
FIELD ALGEBRA AND SU(2) X SU(3) X T-24 SYMMETRY GROUP
V. A. Matveev, R. M. Muradyan, and A. N. Tavkhelidze 1968 10 p refs
(JINR-P2-3858)

The commutation relations of the field algebra are used to describe the states of particles at rest. There appears, naturally, instead of the SU(6) algebra, the system of commutation relations of the Lee algebra of the SU(2) × SU(3) × T_{24} group, obtained previously in the strong coupling theory. In particular, in the axial current the ratio d/f is found to be 3, which disagrees with the result of SU(6) and agrees both with that of the superconvergent dispersion sum rules and with the hypothesis of nonadditive quark currents.
Author (NSA)

N68-38003# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
RELATIVISTIC MODEL OF MESON RESONANCES WITH A LINEAR SPECTRUM
V. A. Matveev and R. M. Muradyan 1968 8 p refs In RUSSIAN
(JINR-P2-3859)

A linear dependence between the spin and the square of a compound particle mass was obtained from the relativistic equation for the fermion–antifermion system. The result is applied for classification of the heavy meson resonances with I = 1, which go into four straight-line Regge-trajectories, considered previously by Dalitz. It also follows from the model that the parameters, which determine the trajectory slopes, are connected by the ratios: $\alpha'_{\pi}(0) = \alpha'_{A_1}(0)\,[1/\alpha'_{\rho}(0) + 1/\alpha'_{\pi_2}(0) = 2/\alpha'_{\pi}(0)]$ which are valid for a chosen position of particles on the trajectories.
Author (NSA)

N68-38004# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MESIC ATOM PROCESSES AND LARGE MESIC MOLECULES MODEL
S. S. Gershtein, V. I. Petrukhin, L. I. Ponomarev, and Yu. D. Prokoshkin 1968 64 p refs In RUSSIAN
(JINR-P4-3860)

Recent experimental and theoretical papers in which the processes of the meson absorption in chemical compounds was investigated are reviewed. Special attention is paid to the recently observed relationship between the chemical properties of materials (which are determined by the structure of the valence electron shells) and the peculiarities of the absorption of mesons by nuclei in these materials.
Author (NSA)

N68-38019# Brookhaven National Lab., Upton, N. Y.
AN INVESTIGATION OF LOW-MULTIPLICITY FINAL STATES IN pp INTERACTIONS AT 28.5 GEV/c
W. E. Ellis, D. J. Miller, T. W. Morris, R. S. Panvini, A. M. Thorndike et al [1968] 60 p Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(BNL-12673; CONF-680809-10) CFSTI: HC $3.00/MF $0.65

Results are presented from a 28.5-GeV/c p + p bubble chamber experiment for the study of single isobar production. The three-body $p\pi^+$ and $\Delta^{++}(1236)p\pi^-$ final states observed in the data are fitted by a double Regge pole exchange model calculation. The 1400 MeV enhancement, and fits to several kinematical variables, for the $p\pi^+$ and Δ^{++} final states, obtained from the double Regge calculation are discussed.
NSA

N68-38028# Joint Inst. for Nuclear Research, Dubna (USSR).
N-N SCATTERING PHASE SHIFT ANALYSIS AT ENERGIES NEAR 20 MeV WITH A NEW METHOD OF PHASE SHIFT SETS TESTING
S. I. Bilen'kaya, I. Bystritskii, Z. Yanout, Yu. M. Kazarinov, and F. Leger et al 1968 30 p refs Submitted for publication
(JINR-E1-3899)

The results of a phase-shift analysis at the energies of 23.1 and 18.2 MeV are discussed. Two and three solutions remain at the first and second energy, respectively. Measurements of triple n-p scattering parameters are necessary for obtaining the unambiguity of solutions. It is shown that the Berkeley p-p polarization data at 19.7 MeV are in disagreement with other results. For the discrimination of phase-shift solutions, the new so called τ-criterion, based on the calculation of some function τ of the experimental data, is used. This method can be applied, in general, to the arbitrary unambiguous phase-shift analysis. The

τ-criterion is more powerful than the χ^2-criterion, e.g., for rejecting the less probable set it is necessary to have a smaller quantity of experimental points (in the statistics it means, that the τ-criterion gives a smaller Type II error). For the calculation of the quantity τ, the standard program for phase-shift analysis with a small additional part can be used. Author (NSA)

N68-38058# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
APPEARANCE OF THE REGGE POLES WHILE SCATTERING IN THE COULOMB FIELD
M. A. Liberman 1968 12 p refs In RUSSIAN
(JINR-P2-3866)

The Regge poles, which appear while scattering in the Coulomb field, were considered. It is shown that the Regge "daughter trajectories" are due to the existence of the dynamical symmetry group of the Coulomb problem. Author (NSA)

N68-38081# Purdue Univ., Lafayette, Ind.
MESON STATES IN POSITIVE PION d REACTIONS AT 2.7 GeV/c
D. Avison, S. Lichtman, C. Ezell, J. Campbell, A. F. Garfinkel et al Jul. 1968 26 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(Contract AT(11-1)-1428)
(COO-1428-70; CONF-680809-1) CFSTI: HC $3.00/MF $0.65

A preliminary report is given on the production of meson resonances in $\pi^+ + d$ reactions at 2.7 GeV/c. The data were obtained from the analysis of 100,000 pictures of a D_2 chamber. The reactions studied are $\pi^+ + d \rightarrow 2p + \pi^+ + \pi^- + \pi^0$ (for which the analysis is nearly complete), $\pi^+ + d \rightarrow 2p + \pi^+ + \pi^- + (MM \geq 2\pi^0)$, $\pi^+ + d \rightarrow 2\pi^+ + 2\pi^- + \pi^0$, and $\pi^+ + d \rightarrow 2p + K^+ + K^-$. The meson resonances η^0, ω^0, H, A_1, and A_2 are studied in the first reaction. The π(960) is studied in the second and third reactions, and the Λ(1520) is studied in the last reaction. NSA

N68-38086# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INVALIDITY OF TCP-THEOREM FOR INFINITE COMPONENT FIELDS
A. I. Oksak and I. T. Todorov 1968 11 p refs Submitted for publication
(JINR-E2-3854)

Necessary conditions are given for the TCP invariance of a local field with usual energy-momentum spectrum. Examples are constructed of both Fermi- and Bose-local free infinite-component fields which violate these conditions and consequently do not allow a TCP symmetry. Author (NSA)

N68-38115# Oklahoma Univ. Research Inst., Norman. Physics Dept.
THEORETICAL STUDIES ON INELASTIC COLLISIONS OF ELECTRONS WITH ATOMS AND MOLECULES Final Report, Jan. 1965–May 1968
Chun C. Lin May 1968 30 p refs
(Contract AF(628)-4973)
(AFCRL-68-0299; AD-674065) CFSTI: HC $3.00/MF $0.65

Electron excitation cross sections of the transitions between the three spin multiplets $J = 0,1,2$ of the $(1s)^2(2s)^2(2p)^4 3p$ ground state of the neutral oxygen atom were calculated for electron energies of 500-10,000K using the method of partial-wave analysis. Under an exact-resonance approximation, the scattering equations for the s-wave and p-wave can be obtained by numerical iteration. Vibrational excitation cross sections of diatomic molecules were calculated using the Born approximation by including the polarization interaction between the incident electron and the molecule. For the non-polar molecules, the polarization term increases the cross sections by an order of magnitude or more over the previous calculations, while in the case of the CO molecule, the contribution from the polarization term is comparable to that from the monopole-dipole interaction. The method of close coupling has been applied to calculate the electron excitation cross sections of helium. For the 1P states the close-coupling cross sections are nearly the same as the Born values, but the former became four times and forty times larger than the latter for 1D and 1F, respectively. The increase in cross sections may be ascribed to the indirect coupling via the 1P states. Author (TAB)

N68-38156# Stanford Univ., Calif. High Energy Physics Lab.
INELASTIC ELECTRON SCATTERING STUDIES FROM Ca-40 AND Ca-48
P. D. Zimmerman, M. R. Yearian, and T. W. Donnelly Jun. 1968 7 p refs Submitted for publication
(Contracts Nonr-225(67); F44620-68-C-0075)
(HEPL-568; ITP-305; AD-673962) CFSTI: HC $3.00/MF $0.65

Elastic electron scattering studies from isotopes of calcium are briefly summarized. A study of the inelastic level structure of Ca40 and Ca48, as well as the quasi-elastic scattering from both isotopes was initiated. Preliminary results show the probable existence of excited levels or groups of levels previously unreported from electron scattering experiments. Especially interesting is the appearence of an edge in the Ca40 spectrum beginning at an excitation energy of 15.7 MeV corresponding to the threshold of the state (Ca39 + n). TAB

N68-38165# Technische Hochschule, Karlsruhe (West Germany). Physikalisches Institut.
ELECTRON SPIN POLARIZATION BY LOW ENERGY SCATTERING
J. Kessler Apr. 1968 81 p refs Submitted for publication Sponsored in part by Deutsche Forschungsgemeinschaft and Bundesmin. fuer Wiss. Forsch. Prepared in cooperation with Stanford Univ.
(Contract Nonr-225(67))
(HEPL-532; AD-673963) CFSTI: HC $3.00/MF $0.65

The status of theory and experiment of electron polarization by scattering at energies between a few eV and a few keV is reviewed. Polarization effects in scattering from free atoms, molecules, and solid targets are discussed. Apart from a survey of the problems which have been solved, a perspective is given of the work which would be interesting to pursue in this rapidly developing field of research. Author (TAB)

N68-38182# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
PROGRAM OF PHYSICAL EXPERIMENTS ON A 1000 GeV CYBERNETIC PROTON ACCELERATOR
B. A. Dolgosheina et al Jun. 1968 272 p refs Transl. of the book "Programma Fizicheskikh Eksperimentov Na Kiberneticheskom Uskoritele Protonov Na Energiya 1000 GeV"
(AEC-TR-6936) CFSTI: HC $3.00/MF $0.65

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N68-38183# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

QUESTIONS OF THE THEORY OF THE INTERACTION OF ELEMENTARY PARTICLES AT ENERGIES OF APPROXIMATELY 10^{12} EV

In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 1–34 refs (See N68-38182 24-24)

Introductory remarks on problems of the theory of interaction of elementary particles at energies of $\approx 10^{12}$ and 10^{13} to 10^{15} eV are reported. Discussed are important questions which appear to be fundamental for an experimental check and a critical review of the bases of existing concepts about the processes occurring in the microcosm. Considered are problems related to: the classification of strong and weak interactions; the basic principle of modern quantum field theory; elementary length and the scatter relationship; Pomeranchuk's theorems; the real part of forward scatter amplitude; the method of complex moments; multiple processes; the development of a theory of strong interactions; the hypothesis of universal weak interaction; limits of applicability of local quadruple-Fermi interactions; the existence of W-bosons; the possible relationship between strong and weak interactions; the evaluation of several effects of interaction at very high energies on the basis of modern theory; elementary length; scatter relationships; cross sections in the region of high energy; resonances with large masses; the saturation of weak interactions; Lorentz invariancy; multiple generation of μ-mesons; and gammanization. S.C.W.

N68-38184# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

SPACE-ENERGY DISTRIBUTIONS OF NUCLEAR-ACTIVE AND DECAY PARTICLES

In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 35–55 refs (See N68-38182 24-24)

Reported are models and empirical formulas for computing (1) the energy and angular distribution of π-mesons formed after the collision of high energy (1000 GeV) protons with a nucleon of a target; (2) the space-energy distribution of K-mesons and antiprotons; (3) the space-energy distributions of μ-mesons and neutrinos which originate basically as a result of π-meson decay; and (4) and the space-energy distribution of photons resulting from meson decay. S.C.W.

N68-38185# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

BASIC PROGRAM OF EXPERIMENTS AND EXPERIMENTAL POSSIBILITIES FOR THE INVESTIGATION OF THE INTERACTION OF PARTICLES WITH SUPERHIGH ENERGIES

In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 56–80 refs (See N68-38182 24-24)

A general program of experimental investigations on the physics of strong and electromagnetic interactions which can be realized on a 1000 GeV proton accelerator is outlined, and existing techniques for analyzing the character of the generation of particles at high energies are evaluated. The experimental program is based on available results of cosmic ray studies and studies of large modern accelerators. Studies of strong interactions of elementary particles focus on measurements of (1) global characteristics; (2) elastic scatter; and (3) inelastic processes. Studies of electromagnetic interactions include investigations of the structure of elementary particles at small ranges; and studies of photo- and electrical generation of elementary particles and resonances. The feasibility of creating pencils of various elementary particles and the arrangement of experiments for the investigation of their interactions at energies of 100 to 1000 GeV is discussed. Also discussed are methods of identification (time separation) of pencils of particles among which are cited: Cerenkov counters, the identification of particles according to the relativistic rise of ionization, multisectional proportional counters, multisectional low-effect detectors, and secondary emission detectors. Experimental apparatus for recording the products of high energy nuclear reactions include scintillation detectors, gas Cerenkov counters, spark chambers, semiconductor detectors, and bubble chambers. The applicability of nuclear photoemulsion is also assessed. S.C.W.

N68-38186# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

EXPERIMENTS ON THE MEASUREMENT OF FULL CROSS-SECTIONS OF INTERACTIONS

In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 81–90 refs (See N68-38182 24-24)

Described are experiments focusing on the measurement of full cross sections of interaction on superhigh energy accelerators which were designed to solve the following problems: (1) measuring the progress of the full cross section of interaction σ_t at energies unavailable to modern accelerators with a precision considerably higher than for measuring cosmic rays; (2) checking Pomernachuk's theorem which predicts the equality of full cross sections of particle and antiparticle interaction $[\sigma_t(A+B) = \sigma_t(\bar{A}+\bar{B})]$ at asymptotically high energies; and (3) establishing the existence of heavy resonance of particles which may appear as peaks on the curve of the relationship between the full cross sections of the interaction and the energy of the particles. Specifications for two typical experiments on the measurement of a full cross section of interaction which makes it possible to formulate requirements for pencils, recording apparatus, and experimental rooms are given. The two experiments focus on (1) the measurement of a full cross section of interaction of protons, $\pi-$, K-mesons, and antiprotons with protons and neutrons at pulses of 30 to 200 GeV/c with a precision of up to 1 percent by the method of pencil depletion; and (2) the measurement of full cross sections of the interaction of p, π^+, K^+, $\bar{p}$ with protons and neutrons with a precision of about 1 percent in the pulse interval of 200 to 1000 GeV/c. S.C.W.

N68-38187# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

EXPERIMENTS ON THE MEASUREMENT OF CROSS-SECTIONS OF ELASTIC SCATTER

In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 91–112 refs (See N68-38182 24-24)

Specifications for several typical experiments on the measurement of cross sections of the elastic scatter of protons, $\pi-$, K-mesons and antiprotons by protons and neutrons at pulses of 100 to 1000 GeV/c are given. The proposed experiments are schematic in nature and are designed to give an idea of the possible methods of setting up experiments at superhigh energies and to formulate basic requirements with respect to pencils of particles, recording apparatus, and experimental rooms. The proposed experiments focus on (1) measurement of the differential cross

section of elastic pp-scatter in the region of small transmitted pulses $q^2 = -t \leq 0.02$ (GeV/c)^2 at a pulse of a proton pencil of 50 to 1000 GeV/c; (2) the absolute measurement of the differential cross section of elastic pp-scatter in the region of the diffraction peak, i.e., in the interval of squared transmitted pulses $\approx 0.2 < -t < 1$ (GeV/c)^2; and (3) the measurement of the absolute value of a differential cross section of elastic scatter of $\pi-$, K-mesons, and antiprotons with pulses of 100 to 1000 GeV/c by protons. S.C.W.

N68-38188# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
EXPERIMENTS OF MULTIPLE CREATION AND FORMATION OF RESONANCES
In its Program of Phys. Expt. on a 1000 GeV Cybernetic Program Accelerator Jun. 1968 p 113-124 refs (See N68-38182 24-24)

Promising areas for experimental research which will aid in solving the general problem of strong interactions (superhigh energy physics) are described. Focused on is the importance of studies of the characteristics of multiple creation at energies of about 1000 GeV, and the formation of resonance states. Possible experimental problems which could be solved as a result of studies in the above cited areas include those involving multiplicity, energy distribution, angular distributions of secondary particles, mass spectra of secondary particles, and resonance in processes with low multiplicity. The accuracy of required apparatus for proposed experiments such as the use of photoemulsions, spark chambers, bubble chambers is discussed; and technical problems associated with the creation of bubble chambers with useful volumes of tens of cubic meters are examined. S.C.W.

N68-38189# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
EXPERIMENTS ON ELECTROMAGNETIC INTERACTIONS
In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 125-138 refs (See N68-38182 24-24)

Possible experiments for the study of electomagnetic interactions on a 1000 GeV proton accelerator are briefly described. Considered are studies of quantum electrodynamics and its verification; weak interactions; electromagnetic interactions of adrons; and studies focusing on the verification of quantum field postulates. Also discussed are experimental possibilities of investigating electromagnetic processes, and experiments on the investigation of electromagnetic processes in various pencils. Included is an assessment of the methods for monochromatization and formation of γ, e+, and e- pencils necessary for the study of electromagnetic processes, i.e., pencils of $\pi-$, K-mesons, antiprotons, and μ-mesons. S.C.W.

N68-38190# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
EXPERIMENTS WITH NEUTRINOS AND MUONS
In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 139-177 refs (See N68-38182 24-24)

Discussed are basic directions for experiments with neutrinos and μ-meson particles on the 1000 GeV proton accelerator, a preliminary plan for a system of forming μ-meson and neutrino pencils; a method for conducting experiments; and the design of neutrino and μ-meson laboratories. S.C.W.

N68-38191# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
PENCILS OF PARTICLES AND EXPERIMENTAL ROOMS
In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 178-187 (See N68-38182 24-24)

Summarized are technical characteristics of physical experiments proposed for the cybernetic accelerator. Included are general requisites for pencils of particles; experimental rooms (dimensions power supply, safety, etc.); and auxiliary installations and complexes. The proposed physical experiments are divided into three large classes with respect to the types of interactions studied. Of interest are investigations of (1) strong interactions; (2) electromagnetic interactions at supherhigh energies; and (3) weak interactions. S.C.W.

N68-38192# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
CALCULATION OF PROTECTION AGAINST IONIZING RADIATION
In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 188-202 refs (See N68-38182 24-24)

Calculations are given for the protection of the following against ionizing radiation: the ring of the basic 1000 GeV accelerator; the external target of the basic accelerator; the sides of the target room; the back wall of the target room; the target room in the forward direction; the 18 GeV proton synchrotron-injector; and the linear accelerator injector. S.C.W.

N68-38193# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
THE USE OF AN 18 GeV PROTON SYNCHROTRON-INJECTOR (BOOSTER) FOR PHYSICAL INVESTIGATIONS
In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 203-215 (See N68-38182 24-24)

In the project of the 1000 GeV proton accelerator being designed, it is proposed that a cyclical accelerator booster operating at a frequency of up to 25 Hz be used as an injector. Considered is the possible use of the booster accelerator for physical experiments in the intervals between the injections. It is postulated that the booster accelerator has applications in experiments on pencils of K-meson and antiproton particles, and with storage rings on antiprotons. General pencil requirements; proposed pencils consisting of antiprotons, K-mesons, π-mesons, and neutrinos; experimental pavilion design considerations; secondary particle channel arrangements; electrical power supplies for magnets and lenses; and auxiliary technological systems are assessed. S.C.W.

N68-38194# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
SEPARATING CHANNEL
In its Program of Phys. Expt. on a 1000 GeV Cybernetic Proton Accelerator Jun. 1968 p 216-232 refs (See N68-38182 24-24)

Design considerations and dynamic characteristics of a proton accelerator waveguide separating channel are discussed. The range of the regulated pulses of particles in the separating channel is limited to 100 to 350 GeV/c. The minimal pulses are equal to 140 GeV/c for kaons and 280 GeV/c for antiprotons. Basic parameters, tolerances, rooms, and power consumption requirements of the following channel elements are discussed: the pulse outlet system, the optical system, the high frequency system, and the vacuum system. S.C.W.

N68-38243# Navy Dept., Washington, D. C. Translation Div.
THE ATOMIC INDUSTRY [ATOMNAYA PROMYSHLENNOST]
P. T. Astashenkov 22 Jul. 1968 227 p refs Transl. into ENGLISH from At. Prom. (Moscow), 1956 237 p
(NIC-TRANS-2653; AD-674339) CFSTI: HC $3.00/MF $0.65

In the USSR a leading atomic industry has been created and is developing successfully. This branch of production also exists in other countries of the world. In this book an attempt has

been made using the materials which have been published in the Soviet and foreign press and on the basis of the achievements of Soviet and foreign technology to give an account in popular form of the most important aspects of the production picture of a modern atomic industry. Author (TAB)

N68-38308# Politechnico di Torino (Italy). Instituto di Meccanica Applicata.
ON THE BEHAVIOUR OF A MOLECULAR BEAM SCATTERED BY A SOLID SURFACE: ADDITIONAL THEORETICAL STUDY FOR NORMAL INCIDENCE
Silvio Nocilla and M. Grazia Chiado'piat May 1968 27 p refs
(Grant AF-EOAR-66-28)
(AF-OSR-68-1746; SR-7; TN-43; AD-674288) CFSTI: HC $3.00/MF $0.65

The present paper deals with the problem of the surface interaction between a rigid surface and a molecular beam normally incident on it. The interaction model is here generalized by introducing a suitable energy parameter which simulates the effect of the dissipative forces acting during the collisions between the surface atoms and the incident molecules. Then, the normal pressures and the total translation energies of all the scattered molecules, as well as the corresponding accommodation coefficients, are calculated. Then, a similarity rule between the above mentioned pressures and energies is deduced. At last, the obtained theoretical results are compared with the experimental ones deduced by Stickney and Hurlbut. Author (TAB)

N68-38311# Politecnico di Torino (Italy). Instituto pi Meccanica Applicata.
ON THE BEHAVIOUR OF A MOLECULAR BEAM SCATTERED BY A SOLID SURFACE: THEORETICAL STUDY FOR NORMAL INCIDENCE
Silvio Nocilla and M. Grazia Chiado-Piat Sep. 1967 21 p refs
(Grant AF-EOAR-28-66)
(AFOSR-68-1734; SR-1; TN-37; AD-674289)

The paper deals with the problem of the scattering of a molecular beam normally incident on a solid surface. By means of a suitable interaction model which takes into account the thermal motion of the surface atoms and the surface roughness at molecular scale the velocity distribution function of the free-molecule surface source formed by the re-emitted molecules is determined. Successively the corresponding spatial distribution functions of the number of molecules, of their momentum and of their energy are calculated. Author (TAB)

N68-38315# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANGULAR ENERGY SPECTRA OF FAST NEUTRONS BEHIND IRON SHIELDS [UGLOVYE ENERGETICHESKIE SPEKTRY. BYSTRYKH NEITRONOV ZA ZHELEZNYMI EKRANAMI]
T. A. Germogenova et al 2 Nov. 1967 19 p refs Transl. into ENGLISH from Vopr. Fiz. Zashchit. Reaktorov (USSR), no. 2, 1966 p 74-87
(FTD-MT-24-253-67; AD-674676) CFSTI: HC $3.00/MF $0.65

Some results are given from calculations of the energy and angular distributions of fast neutrons behind flat iron plates of various thickness. TAB

N68-38331# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SHRINKAGE OF THE FORWARD AND BACKWARD DIFFRACTION OF PEAKS
Nguyen Van Hieu, Nguyen Ngoc Thuan, and J. A. Suleimanov 1968 20 p refs
(JINR-P2-3897)

Various upper bounds for the ratios of the differential to the total cross sections of the elastic and inelastic processes are established. It was shown also that Orear's empirical formula contradicts the Mandelstam representation. Author (NSA)

N68-38335# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
RADIATIVE CAPTURE OF NEUTRONS IN THE REGION OF THE DIPOLE GIANT RESONANCE. PART 2: CALCULATION
F. Cvelbar, A. Hudoklin, M. V. Mihailovic, M. Najzer, and M. Petrisic Apr. 1968 19 p refs Submitted for publication
(NIJS-R-529) CFSTI: HC $3.00/MF $0.65

Spectra of gamma-rays from the radiative capture of 14.1 MeV neutrons by nuclei ^{32}S, ^{52}Cr and ^{56}Fe were calculated and compared with the experimental data. The calculation was performed according to three different formulations of direct-semidirect theory using neutron wave functions for the Woods-Saxon potential with spin-orbit coupling term. The contribution to the gamma-ray spectra from the capture via formation of the compound nucleus was also calculated. The results show that all three direct-semidirect models give a reasonably good agreement with the experiment in the excitation energy region from zero to about 5 MeV. At higher excitation energies the direct-semidirect theory gives much smaller cross section than the measured one. In this energy region the capture via formation of the compound nucleus accounts for an appreciable part of the transition strength. Author

N68-38339# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
WKB METHOD OF SOLVING THE PROBLEM OF CONFIGURATIONAL INTERACTION OF TERMS IN THE ZEZ SYSTEM
L. I. Ponomarev 1968 20 p refs
(JINR-P4-3842)

The phenomenon of the pseudointersection of the terms in the ZeZ system, which was observed recently, is discussed. By means of the WKB method the formulas were obtained for the value of splitting the δE levels at the point of pseudointersection, as well as the R_0 distances between the charges Z and Z, at which these pseudointersections appear, the E_0 energy values in the point of pseudointersection and the function determining the total number of such pseudointersections in the system ZeZ, at given values of charges Z and Z, and quantum numbers n and n, of interacting terms. The formulas obtained are compared with the numerical calculations. Author (NSA)

N68-38370# Stanford Univ., Calif. High Energy Physics Lab.
A HIGH ENERGY, SMALL PHASE-SPACE VOLUME MUON BEAM
W. L. Lakin, J. Cox, F. Martin, M. L. Perl, T. H. Tan et al Jun. 1968 35 p refs Submitted for publication
(Contract Nonr-225(67))
(HEPL-565; SLAC-PUB-434; AD-673961) CFSTI: HC $3.00/MF $0.65

The design and performance of a high-momentum, small phase-space volume muon beam is described. The muons are photoproduced by the bremsstrahlung of electrons incident on a thick target. Pion contamination is reduced to .000003 of muon flux by a 5.5 meter beryllium filter placed immediately after the target. The optical system has two stages of momentum analysis to give an almost disperaion free beam, and a final imaging stage to clean up the tails of the beam distribution. Standard B. N. L. 3Q48 and 18D72 magnets are used throughout. At 10 GeV/c, the beam yields 100,000 muons/second in a phase-space volume of .003 sq cm steradians and a momentum band of plus or minus 1.5%. Author (TAB)

N68-38465# Los Alamos Scientific Lab., N. Mex.
ELECTRON-ELECTRON INTERACTION FROM SINGLE-ELECTRON THEORY
Walter F. Huebner 24 Jul. 1968 63 p refs
(Contract W-7405-ENG-36)
(LA-3899) CFSTI: HC $3.00/MF $0.65

Electron–electron Coulomb interaction energies are expressed in terms of relativistic one-electron orbitals. The $F^{(0)}$ Slater integrals are tabulated using hydrogenic Dirac wave functions for Z = 1, 30, 56, 74, and 92. The average electron–electron interaction energy, τ, is obtained and tabulated for the same values of Z, for electron configurations in j-j coupling, from relativistic $F^{(0)}$ and nonrelativistic $G^{(k)}$ integrals, with $k \leq 6$. Interpolation formulas are given to obtain τ at other values of Z. An approximate method is proposed for obtaining blinding energies for the electrons in ions in their ground state, and for ions and neutral atoms in excited states, from known binding energy data of neutral atoms corrected by the electron–electron interaction energy. Author (NSA)

N68-38499# California Univ., Livermore. Lawrence Radiation Lab.
CALCULATION OF FORWARD BREMSSTRAHLUNG SPECTRA FROM THICK TARGETS
W. C. Dickinson and E. M. Lent 6 Jun. 1968 24 p refs
(UCRL-50442) CFSTI: HC $3.00/MF $0.65

Calculations of forward (0°), thick-target bremsstrahlung spectra were made for electron energies from 1 to 10 MeV and for a wide range of target Z. The effects of electron scattering, energy loss, collision straggling, transmission, and photon attenuation were included. Excellent agreement was obtained with the experimental results of Dance and co-workers for stopping targets of Al, Fe, Sn, and Au at energies of 1.0, 2.0, 2.8, and 3.0 MeV. Also good shape agreement was obtained with the measured spectra for 5- and 10-MeV electrons incident on a thick W target. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-37429 Colorado Univ., Boulder.
EXPERIMENTS ON TRANSVERSE IONIZING MHD SHOCK WAVES
Charles Fleming Stebbins (Ph.D. Thesis) 1967 99 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2637

The jump conditions across a transverse ionizing MHD shock wave, where the magnetic field is in the plane of the shock, are examined. The simple conservation laws, in conjunction with Maxwell's laws and the equation of state, yield three jump equations in four unknowns. The ionizing wave, then, requires an additional descriptive relationship for a unique solution to the jump equations to exist. Several theories which attempt to supply this missing relationship are examined. Lyubimov and Kulikovskii show, for appropriate ratios of the thermal diffusivity to the magnetic diffusivity, that for low speed shock waves the magnetic field compression across the shock is unity and the jump equations reduce to the ordinary Rankine—Hugoniot relations. For high speed shock waves, the magnetic field compression is equal to the gas compression across the wave and the jump equations become exactly the magnetohydrodynamic jump relations. Furthermore, intermediate speed shocks experience a magnetic field compression between 1 and ρ_2/ρ_1. Dissert. Abstr.

N68-37443 Northwestern Univ., Evanston, Ill.
FLOW PHENOMENA IN A MULTICIRCUIT CONICAL ELECTROMAGNETIC SHOCK TUBE
David Sanborn Scott (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3220

A multicircuit conical electromagnetic shock tube was conceived, designed and assembled in an effort to eliminate several undesirable features present in previously existing designs. The major design innovation was the removal of the conventional ring electrode and its replacement by 12 electrically isolated electrode pins. This was done to reduce current streamer wandering and to provide a more symmetric energy addition. The performance of this new facility was then determined emphasizing: the success of the trigger design in terms of reliability, component performance and firing simultaneity; the stability, symmetry and termination of the 12 streamer discharge; the dependence of discharge rates on voltage and pressure; the symmetry and velocity of the incident and reflected luminous fronts; the plasma homogeneity and velocity; the existence of an interaction zone; and the temperature and other properties of the reflected plasma. Although the performance evaluation indicated a significant degree of success with regard to trigger performance and other phenomena directly associated with the electrical design, plasma flows emanating from the driver showed only slight improvements over existing facilities. Dissert. Abstr.

N68-37446# Brookhaven National Lab., Upton, N. Y.
MICROWAVE CAVITY METHOD OF STUDYING RECOMBINATION FOLLOWING PULSE RADIOLYSIS
L. A. Ferrari (Queens Coll.) and M. S. Zucker Jun. 1968 14 p 3 refs Sponsored in part by AEC
(BNL-12552; CONF-680806-1) CFSTI: HC $3.00/MF $0.65

A method is reported for study of recombination in ionized media at neutral and charged particle densities that are so high that the usual methods of creating ionization are unsatisfactory. The pulsed 1.75-MeV electron beam from the accelerator is collimated and allowed to enter the gas-filled cylindrical cavity through a foil, causing a well-defined column of ionization coaxial with the cavity. The cavity is used as a microwave transmission filter and thus passes a maximum amount of microwave power when its resonant frequency equals that of the microwave signal generator. Data on the relation of electron density to time after passage of the electron pulse can be obtained by offsetting the frequency of the signal generator by successive amounts and photographically recording the resulting oscilloscope traces. NSA

N68-37447 Missouri Univ., Columbia.
PULSED ELECTRICAL POWER GENERATION FROM MAGNETICALLY LOADED EXPLOSIVES
Charles Neal Mc Kinnon, Jr. (Ph.D. Thesis) 1966 137 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-2865

This study is concerned with the generation of pulse electrical power from condensed explosives by magnetohydrodynamic means. An analysis of the process, based on the overall electrical circuit viewpoint, indicated that the magnetic Reynolds number, R_m, of the interaction should be maximized. Of the several variables constituting R_m, the increase of electrical conductivity of the detonation products offers the best possibility from increasing R_m. Enhancement of detonation zone electrical conductivity by means of the magnetic particle conductivity was investigated. Results of experiments are in general agreement with a theory which is an extension of a simple model based on a mixture of two conducting phases. The electrical conductance was found to vary exponentially with the fraction of metal present in the explosive. The detonation velocity, which also directly influences R_m, decreases at high metal fraction indicating an optimum value of R_m exists near 80% metal

fraction by weight. An increase in R_m by a factor of ≈20 appears feasible. The results indicate a practical device could be constructed employing this principle. Dissert. Abstr.

N68-37454 New Mexico Univ., Albuquerque.
GENERALIZED TRANSPORT EQUATIONS FOR PARTIALLY AND FULLY IONIZED NONEQUILIBRIUM GASES
Dermod Kelleher (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-3471

Transport equations are developed for the number densities, mean velocities, temperatures, stresses and heat fluxes of the constituents of an ionized gas by taking velocity moments of the Boltzmann equation. These equations are closed out by utilizing the Grad 13-moment approximation for each distribution function. These equations, coupled with Maxwell's equations to describe the electric and magnetic fields, constitute a closed set. This set of equations is anticipated to have validity for plasma systems of arbitrary degree of ionization, the constituents of which need not be close to thermodynamic equilibrium with each other. By limiting attention to systems with slowly varying flows, transport expressions, which reflect the influence of electric and magnetic fields, have been extracted and exhibited. Dissert. Abstr.

N68-37487 Northwestern Univ., Evanston, Ill.
AN INVESTIGATION OF NON-EQUILIBRIUM IN AN RF PLASMA
Paul Drummond Scholz (Ph.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3218

The types of equilibrium and nonequilibrium in an inductively sustained RF argon plasma were investigated using emission spectroscopy as the diagnostic tool. The experimental study was carried out using an RF plasma with a fixed oscillator frequency of 4.2 MHz and a fixed plate input power of 2.0 kw. The plasma was contained in a 25 mm i.d. quartz tube which was water cooled. The average, axial, argon, flow velocity was 9.0 cm/sec and the plasma was operated at static pressure levels of 0.01, 0.1, 0.5, and 1.0 atm. The spectral lateral intensity profiles of seven atom lines and the continuum centered at three wavelengths were measured and inverted into radial intensity profiles at each pressure level. The results of the experimental study indicated that the center half of the plasma was in local thermodynamic equilibrium at 1.0 and 0.5 atm. Departure from thermodynamic equilibrium began at 0.1 atm and was quite apparent at 0.01 atm. Dissert. Abstr.

N68-37533 Northwestern Univ. Evanston, Ill.
THE EVOLUTION OF A DENSITY DISCONTINUITY AS GOVERNED BY THE BOLTZMANN COLLISION INTEGRAL
Robert William Springer (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-3224

The problem posed by using a density distribution which is discontinuous at the origin is studied. The method of generalized orthogonal polynomials is applied based on the assumption that for time sufficiently short the flow is very nearly free-molecular. Thus the weight function for the polynomials is taken to be the solution to the same problem in a collisionless gas. A set of moment equations are derived for the case of an inverse fifth power force law. For initial number density ratios small enough the system of equations is hyperbolic, and numerical integration was carried out using the method of characteristics. The results clearly show the early effect of collisions on the initially free-molecule flow. Differences after times of the order of one mean free time in the low density gas can easily be seen. Dissert. Abstr.

N68-37635# Maryland Univ., College Park.
PLASMA IMPEDANCE ELEMENT IN AN ACTIVE FABRY-PEROT MICROWAVE RESONATOR
R. C. Ajmera and H. Leshinsky May 1968 11 p 3 refs
(Contract AT(40-1)-3405-3)
(BN-55) CFSTI: HC $3.00/MF $0.65

Experiments are described in which a plasma is used as an impedance element in an active Fabry–Perot microwave resonator. The system contains a feedback loop with a broadband amplifier (traveling-wave tube) that introduces positive gain into the system. The availability of positive gain offers a number of new and interesting features, one being the use of an active system in plasma-diagnostics applications. The use of a plasma as a power and frequency-determining impedance element in an active system also appears to be a possibility. NSA

N68-37660 Maryland Univ., College Park.
THE HIGH FREQUENCY DIELECTRIC CONSTANT OF THE DEGENERATE ELECTRON GAS
Ronald Jerry Cohn (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-3348

A review of the dielectric constant description of the degenerate electron gas is given. The connection between the frequency and wave-number dependent dielectric constant, $\epsilon(k,\omega)$, and the plasma oscillation of the electron gas is stressed. The previous calculations of $\epsilon(k,\omega)$ by Lindhard, Dubois, and Glick are discussed using the techniques of the modern manybody perturbation theory. In particular, it is shown that their determinations of $\epsilon(k,\omega)$ have the property that $\epsilon_2(k,\omega) = 0$ for $\omega > kv_0$ (where v_0 is the velocity of electrons at the Fermi surface). When $\omega_p > kv_0$ for small k, their values for $\epsilon_2(k,\omega)$ and γ are zero implying the unphysical result that the plasmon has an infinite life time. In order to obtain a finite lifetime for the plasmon, the previous calculations of $\epsilon(k,\omega)$ are extended to the high frequency region. Dissert. Abstr.

N68-37738# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES Quarterly Report, 1 Sep.–30 Nov. 1967
3 Nov. 1967 17 p 3 refs
(Contract AT(40-1)-3405)
(TID-24563; QR-8) CFSTI: HC $3.00/MF $0.65

The installation of the Q machine was completed, and some preliminary experiments and calibration are described. With the machine in operation, the program was provisionally divided into three major parts: (1) physics of plasma waves and instabilities, (2) physics and technology of Q machines, and (3) general experimental methods. A brief description of these topics and some early results are given. Author (NSA)

N68-37760# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
[RESEARCH LABORATORY OF ELECTRONICS] Quarterly Progress Report
H. J. Zimmermann, G. G. Harvey and S. J. Mason 15 Apr. 1968 287 p
(QPR-89; AD-669231)

Contents: Atomic resonance and scattering; Electron magnetic resonance; Radio astronomy; Solid-state microwave electronics; Optical and infrared spectroscopy; Geophysical research; Magnetic resonance; Physical electronics and surface physics; Electrodynamics of media; Plasma physics; Gaseous electronics; Plasmas and controlled nuclear fusion; Spontaneous radiofrequency emission from hot-electron plasmas; Interaction of laser radiation with plasmas and nonadiabatic motion of particles in magnetic fields; Processing and transmission of information; Speech communication; Cognitive information processing; Communications biophysics. TAB

N68-37841*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FLOW PARAMETERS OF THE CORONA
Klaus Schocken 27 Sep. 1968 28 p 6 refs
(NASA-TM-X-53767) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The coronal plasma is assumed to be a fully ionized mixture of two species. Nondimensional parameters are obtained from the fundamental equations of plasma flow. Some thermodynamic properties of the coronal plasma are presented in tables which are based on a coronal model. Author

N68-37912# United Kingdom Atomic Energy Authority, Culham (England).
EXPERIMENTAL INVESTIGATION OF THE EFFECT OF SPACE CHARGE ON THE MOTION OF ELECTRONS IN A MAGNETIC MIRROR TRAP WITH EXTERNAL INJECTION
V. G. Ponomarenko et al Mar. 1968 6 p 3 refs Transl. into ENGLISH from Novosib. Rept., Sep. 1968 p 1-8
(NP-TR-1672; CTO-492) CFSTI: HC $3.00/MF $0.65

It is shown that the space charge from a beam of electrons emitted from a gun leads to the capture in the trap of electrons having magnetic moments which are larger than the moments calculated from adiabatic theory. Author (NSA)

N68-37913# United Kingdom Atomic Energy Authority, Culham (England).
ESTIMATE OF THE EFFECT OF IONIZATION LOSSES ON ELECTRON CONTAINMENT TIME IN MAGNETIC MIRROR TRAPS
V. G. Ponomarenko et al Apr. 1968 8 p 7 refs Transl. into ENGLISH from Novosib. Rept. No. 154, Sep. 1967 p 1-9
(NP-TR-1677; CTO-506) CFSTI: HC $3.00/MF $0.65

The influence of ionization losses on the time dependence of the electron currents leaving the working volume of the trap is analyzed. Relationships are calculated which indicate that the complete loss of collector current is attributable to the circumstance that during the time τ_p the electrons lose practically all their energy by inelastic scattering on the residual gas. The agreement between the experimental data and calculated results is reasonably satisfactory. Author (NSA)

N68-37914# Los Alamos Scientific Lab., N. Mex.
HOLOGRAPHIC DIAGNOSTICS OF A PLASMA
A. N. Zaidel et al Jul. 1968 30 p 36 refs Transl. into ENGLISH from Russian Rept. FTI-085
(LA-TR-68-23)

An attempt was made to evaluate the new possibilities which holography gives for plasma diagnostics, and the results obtained up to the present time are systematized. NSA

N68-37922# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.
ENERGY DISTRIBUTION OF POSITIVE IONS EXTRACTED FROM A HOT-CATHODE GAS DISCHARGE ION SOURCE
Lowell P. Theard Jun. 1968 30 p 18 refs *Its* Res. Commun. No. 65
(Douglas-Paper-5199; AD-674750)

An electrostatic parallel-plate energy analyzer was used for measuring the energy distribution of Ar(+) ions in a beam extracted from a non-magnetic hot-cathode gas discharge ion source under various conditions of source pressure, anode voltage, and anode current. A large number of energy distribution curves were obtained as X-Y recordings. The curve shape depends upon source conditions, though not strongly when the pressure is greater than 0.003 torr with an anode voltage above 50V (for argon) and an anode current of at least 200 mA. When conditions are optimum, the ion energy distribution curve is a narrow peak with a tail that gradually diminishes towards lower energies over an interval of approximately 30 eV. The actual value of the optimum full-width at half-maximum was found to be 1.1 eV by extrapolation to zero beam energy. The shape of the curve is such that more than 81 percent of the beam ions have energies within a 10-eV interval. The source can be used to increase beam currents greatly in certain types of magnetic deflection mass spectrometers without extreme loss of mass resolution due to ion beam energy spread. Author (TAB)

N68-37992# Texas Univ., Austin.
THE THEORY OF PLASMA TURBULENCE AS APPLIED TO EXPERIMENTAL PHENOMENA
W. E. Drummond Apr. 1968 11 p
(Contract AT(40-1)-3458)
(ORO-3458-13) CFSTI: HC $3.00/MF $0.65

The two-stream instability for a cold electron beam passing through a cold plasma is discussed in the limit where the beam density is small compared to the plasma density. The dispersion relation is examined in terms of its topological behavior as the temperature of the beam particles is increased from zero to some finite value. It is shown that the three modes of the two-stream instability go continuously over into the one-mode bump instability. The effects of nonlinearity in systems where a zero temperature beam is passed through a lower-temperature plasma is also considered. NSA

N68-38050# United Kingdom Atomic Energy Authority, Culham (England).
HOLOGRAPHY IN PLASMA DIAGNOSTICS
Z. N. Zaidel, G. V. Ostrovskaya, and Yu. I. Ostrovskii [1968] 27 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Fiz.-Tekh. Inst. (Leningrad), Rept.-85
(NP-tr-1679; CTO-508) CFSTI: HC $3.00/MF $0.65

New possibilities presented by holography in plasma diagnostics are discussed. The results are mainly of an illustrative character. NSA

N68-38070# Office of Naval Intelligence, Washington, D. C. Translation Div.
ON THE STRUCTURE OF SHOCK WAVES [K STRUKTURE UDARNYKH VOLN]
K. Khandrikh 1 Jul. 1968 10 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), no. 5, 1966 p 81-87
(NIC-TRANS-2632; AD-674819)

The structure of shock waves in a thermally conducting viscous gas is examined. A law of conservation of irreversible energy flow within a shock front is derived. Approximate analytic expressions for the integral curve are obtained for the cases where Prandtls number $P >> 1$ and $P << 1$ and for the velocity profile in a plasma with equal electron and ion temperatures in the approximation $P = 0$. Author (TAB)

N68-38128# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
COMMENTS ON "TURBULENT SHOCK WAVES IN PLASMAS"
D. Biskamp and D. Pfirsch May 1968 9 p refs
(MPI-PAE/PL-6/68) CFSTI: HC $3.00/MF $0.65

A critical assessment is presented on the use of the generalized Mott-Smith model for the structure of a strong electrostatic collisionless shock wave. Consideration is given to the one-dimensional case and quasi-linear equations are derived for the velocity distribution function. It is concluded: (1) It is not possible to construct a collisionless shock wave using only the quasi-linear equation, since this is an equation of the first order which does not permit consideration of an asymptotic upstream and downstream state. (2) This indicates that the mean electric potential, which obeys an equation of the second order, will play a decisive role in the formation of the electrostatic shock wave. M.G.J.

N68-38132# Harvard Coll. Observatory, Cambridge, Mass.
THE EQUILIBRIUM STRUCTURE OF A SHOCK-HEATED CORONA
Roger A. Kopp (Ph.D. Thesis) Jun. 1968 308 p refs
(Contract AF 19(628)-3877)
(AFCRL-68-0312; SR-4; AD-674060)

A theory of shock propagation in a spherical atmosphere is presented, which incorporates both the damping of a shock by its wake and changes of shock strength caused by non-uniform properties and hydrodynamic motions in the preshock gas. This theory is applied in conjunction with the time-averaged conservation equations for radial flow to determine the structure of a stellar corona whose quasi-steady dynamical state is maintained by a balance between shockwave dissipation, thermal conduction, radiation, and coronal expansion. For the suns corona, it is shown that a single theoretical model is capable of simultaneously representing observations of coronal electron densities, properties of the solar wind in interplanetary space, and intensities of the solar ultraviolet emission lines. The gross energy balance of an expanding shock-heated corona is discussed, with particular reference to the numerical model which best represents the quietday sun. The processes of radiation, conduction, mechanical dissipation, and convective outflow are each examined as to their relative importance in determining the equilibrium structure of different atmospheric layers. Author (TAB)

N68-38203# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ELECTRIC ARCS IN TURBULENT FLOWS, 3 Interim Report, Feb. 1967–Mar. 1968
Gerhard Frind and Ben Lee Damsky Apr. 1968 63 p refs
(Contract F33615-67-C-1374)
(ARL-68-0067; AD-674614) CFSTI: HC $3.00/MF $0.65

Work is reported on the development of methods to measure arc temperature, axial pressure gradient, plasma flow velocity and radiative heat flux in long cylindrical turbulent arcs. Axis temperature and radial temperature distribution of laminar and turbulent 50 amp. nitrogen arcs of 11.2 atm. pressure were found to be of similar size, with some reservation about the accuracy of the side on turbulent temperature measurement. The problem of measuring average turbulent arc temperatures was discussed; measurements in end on observation and the use of the Milne-Larentz method appear to give better results than side on observation of absolute line intensities. Measurements of the pressure gradient in a 11.2 atm., 125 amp. argon arc show a 1.8 power dependence of pressure gradient on flow rate, indicating that this relationship, well known from cold flow experiments, also holds under the conditions of the experimental arc temperatures. Plasma velocities were measured by time sequential photography of the turbulent arc structure. Author (TAB)

N68-38204# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE NATURE OF RESONANCE PHENOMENA IN RADIO-WAVE SCATTERING ON METEOR-TRAIL MODELS [O PRIRODE REZONANSNYKH YAVLENII PRI RASSEYANII RADIOVOLN NA MODELYAKH METEORNYKH SLEDOV]
I. V. Bairachenko 21 Nov. 1967 8 p Transl. into ENGLISH from Akad. Nauk UkrSSR, Mezhduvedomstvennyy Geofiz. Komitet. Informatsionnyy Byull. (Kiev), no. 9, 1966 p 153–156
(FTD-HT-23-997-67; AD-673926) CFSTI: HC $3.00/MF $0.65

Theories on the nature of plasma resonance are reviewed on the basis of experimental data on resonance scattering of radio waves by models of meteor trails. Experiments were conducted at lambda = 8-13 m with a cylindrical gas-discharge tube (inside diameter, 1.02 cm; length, 70 cm) containing mercury vapor. During the transverse polarization of an incident wave with variations in the discharge current, a series of reflected signal maxima, believed to be caused by resonance phenomena was observed. Fundamental and higher resonance modes were observed, which behaved similarly under various conditions of scattering. Theories based on models of cold plasma could not be confirmed experimentally. Higher resonance modes are attributed to the motion of hot electrons. This phenomenon indicates an interaction between the electric field of the incident radiation and plasma waves. Author (TAB)

N68-38215# Avco Corp., Wilmington, Mass. Missiles Space and Electronics Group.
INVESTIGATION OF ACCELERATION MECHANISMS IN MPD ACCELERATORS Interim Technical Report, 1 Dec. 1966–30 Nov. 1967
A. C. Malliaris Apr. 1968 83 p refs
(Contract F33615-67-C-1209)
(AVSSD-0044-68-CR; ARL-68-0078; AD-674615)

Results are reported from two major phases of this program: (a) consistency tests of induction velometry and determination of radial profiles of the flow velocity, and (b) determination of electric current distribution in the MPD accelerator. The consistency tests are basically aimed at verifying experimentally the validity of the basic relation in induction velometry. Then, a technique based on induction velometry is developed, analyzed, and applied to the determination of radial profiles of the flow velocity. This technique requires probing of the motionally induced potential versus the radius with adequate radial resolution. From such measurements, the radial profiles are determined by a method based on small but finite differences. Many examples are presented and analyzed. The errors of the method are also discussed. The electric current distribution in the accelerator and the nature of the discharge were investigated with sufficient spatial and temporal resolution, using appropriately arranged, floating electrostatic probes. The experimental conditions here were extended over very wide ranges, namely, Gases: H2, D2, He, NH3, N2 and A at flow rates ranging from 0.005 to 0.250 gm/sec, currents from 200 to 2000 amperes and externally applied B fields from 0 to 2500 gauss. Author (TAB)

N68-38261# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE PROBLEM OF PLASMA ACCELERATION IN CROSSED FIELDS [K VOPROSU OB USKORENII PLAZMY V SKRESHCHENNYKH POLYAKH]
N. A. Khizhnyak 4 Oct. 1967 15 p refs Transl. into ENGLISH from the book "Issledovanie Plazmennykh Sgustkov" Kiev, Naukovo Dumka, 1965 p 137–148
(FTD-HT-23-819-67; AD-674672) CFSTI: HC $3.00/MF $0.65

The present work considers the requirements for neutral plasma acceleration in crossed electric and magnetic fields. The analysis is performed for rail gun accelerators. It is shown that when the plasma density of the accelerated plasmoid is high, the plasmoid should be considered as an Ohmic load for typical circuit parameters employed in many experiments. If the density of plasma is low and the same circuit parameters are used, the load is capacitive. For the case of very low density or very low inductance circuit, the inductive characteristics of the plasma load emerge. The first two cases are considered in detail and examples are provided. It is found that the conditions for Ohmic loading of the gun by accelerating plasma are difficult to achieve. In the case of capacitive loading, 20% to 25% of the stored energy can be transferred to the plasma, with the optimum plasmoid velocity being (c/2) (E/H). Such loads are much more easy to achieve than Ohmic loads. It is also noted that account must be taken of the current variation in various portions of the plasmoid, which in turn may induce plasma instabilities which complicate the simplified behavior of plasma acceleration described above. TAB

N68-38267# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SLOW OSCILLATIONS OF THE POTENTIAL IN ELECTRON-ION FLUXES NEAR THE EMITTER [O MEDLENNYKH KOLEBANIYAKH POTENSIALA V ELEKTRONNOIONNYKH POTOKAKH VBLIZI EMITTERA]

V. M. Smirnov 28 Dec. 1967 13 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1966 p 8–14

(FTD-HT-67-457; AD-673934)

An investigation was made of quasistationary distributions of the potential in unidimensional ion-electron flows close to an emitting plane. The role of close collisions is disregarded. Three modes are found; they are unstable with regard to slow variations and boundary conditions. Instability appears as a result of counterflow of slow particles reflected to the emitter by potential barriers in the Debye layer close to the emitter. Instabilities of the first and second type due to the absence of steady-state modes in conditions close to the emitter develop during a time interval of the order of the inverse of the plasma frequency so that the number of reflected particles involved in counterflow is comparable to the total number of particles. An instability of the third type appears in the distributions of the potential when the slow particles emerging from the emitter are first accelerated and only then are attenuated and are reflected to the emitter. A form of an approximate system of equations is established for the case of slow oscillations of time-variable boundary conditions, and solutions of this system are studied. Author (TAB)

N68-38294# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECTIVE OUTLINE OF ELECTRON SCATTERING IN PLASMA, IN HELIUM, AND IN ARGON WITH A MIXTURE OF CESIUM VAPOR [EFEKTYVNYI PERERIZ POZSIYUVANNVA ELEKTRONIV U PLAZMI V HELIYI V ARHONI Z DOMISHKOYU PARY TSEZIYU]

I. M. Polushkin et al 6 Oct. 1967 12 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 9, 1966 p 950–955

(FTD-HT-23-919-67; AD-674224)

The authors measured the effective cross section of electron scattering by neutral atoms of a binary gas discharge plasma in inert gases of He and Ar with an admixture of Cs vapor at a pressure of approx. 2mm Hg. Measurements were carried out by a method employing a superhigh-frequency resonator in the three-centimeter band and by a method of plasma conductivity in a d-c network. Dependences of the electric-field strength and plasma conductivity in He--Cs and Ar--Cs on the Cs vapor pressure are given for various electric-current densities. TAB

N68-38323# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PLASMA TURBULENCE [TURBULENTNOST PLAZMY]

B. B. Kadomtsev 19 Dec. 1967 218 p refs Transl. into ENGLISH from Vopr. Teorii Plazmy (USSR), no. 4, 1964 p 188–339

(FTD-HT-23-778-67; AD-673939)

Contents: The quasilinear approximation; Interaction of waves; Methods of investigating strong turbulence; Turbulent processes in plasma. TAB

N68-38329# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

NUMERICAL COMPUTATION OF THE PRODUCTION OF A DENSE PLASMA BY IRRADIATION OF A SOLID BY A LASER [RECHNUNGEN ZUR ENTSTEHUNG DICHTER PLASMEN BEI BESTRAHLUNG VON FESTKOERPERN MIT LASERN]

P. Mulser and S. Witkowski Jun. 1968 15 p refs In GERMAN; ENGLISH summary

(IPP-3/74) CFSTI: HC $3.00/MF $0.65

A one-dimensional, one-fluid model is assumed in which the light energy is absorbed by the produced plasma according to the local coefficient of absorption and the local light intensity. The degree of ionization is determined by the Saha equation. Heat conductivity is neglected. Numerical results are given for irradiation of a block of solid hydrogen with a light intensity of 10^{12} W/cm^{-2}. The ratio between thermal and kinetic energy proves to be approximately constant. Temperatures of more than $2 \cdot 10^8$ °K and expansion velocities up to $3 \cdot 10^7$ cm/sec are achieved. Author

N68-38333# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE SOLUTION OF PROBLEM ON STATIONARY INDUCED HIGH-FREQUENCY DISCHARGE IN CLOSED VOLUME [PRIBLIZHENNOE RESHENIE ZADACHI O STATISIONARNOR INDUTSIROVANNOM VYSOKOCHASTOTNOM RAZRYADE V ZAMKNUTOM OBEME]

V. A. Gruzdev et al Dec. 1967 18 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1967 p 143–150

(FTD-MT-24-332-67; AD-674695)

A theoretical description of temperature, current and energy distributions in dense plasma discharges is given. It is assumed that the departure from the equilibrium temperature is small and that the dominant energy transfer mechanism is thermal conduction. Since it is assumed that local thermodynamic equilibrium exists, all transfer coefficients are functions of temperature and pressure only, reducing the problem to that of energy balance consistent with Maxwells equations. The method of iterative approximations is used to obtain the solutions. These are determined for specific examples which are used for comparison with the experimental results of other authors. Comparison between computed and experimental results are shown graphically. The disagreements that are evident are ascribed to the experimental interpretations of the data and poorly defined boundary conditions. TAB

N68-38348# Maryland Univ., College Park.

CRITICAL SURVEY OF MAGNETO-FLUID-DYNAMICS. PART 1: RESEARCH IN INDIA. PART 2: RESEARCH IN AUSTRIA AND GERMANY Interim Report

Shih-i Pai Mar. 1968 60 p refs

(Contract AF 33(615)-3968)

(ARL-68-0062; AD-674613) CFSTI: HC $3.00/MF $0.65

In this report, we survey those works in magnetofluid dynamics of those foreign eminent scientists whose works are not well known in the USA, particularly in those research center in India and West Europe (especially Germany and Austria) where the principal investigator had the opportunities to visit during his sabbatical leave from University of Maryland for the Academic year 1966 to 1967. Since the advance of magnetofluid dynamics in general and the advances in research in fluid dynamics would be of interest, we discussed both the research work in magnetofluid dynamics as well as other aspects of fluid dynamics research in India and West European countries. Author (TAB)

N68-38351# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

DETERMINATION OF THE BLAST WAVE ENERGY OF A LASER-INDUCED GAS BREAKDOWN [BESTIMMUNG DER ENERGIE DER STOSSWELLE, DIE VON DEM GASDURCHBRUCH EINES FOKUSSIERTEN LASERS AUSGEHT]

K. Hohla Jan. 1968 55 p refs In GERMAN; ENGLISH summary

(IPP-3/67) CFSTI: HC $3.00/MF $0.65

The gas breakdown was produced in the gases H_2, N_2, He, Ar, and Xe with a 100 MW ruby laser in a pressure chamber, the gas pressure being varied from 200 torr. to 10 atm. A lense with a focal length of 16 mm was used for focusing the laser

beam. The blast wave was observed using the shadow method. An image converter camera was used to take high-speed pictures and streak pircutes. The shape of the blast wave was almost spherical. The time-path dependence of the shock front was determined by streak pictures and compared with Sakurai's theory for spherical blast waves. The normalized time-path curve agrees well with the theoretical curve for H_2 and N_2 for the case that the Mach number $M \geq 2$ as well as for Xe, Ar, and He for the case $M \geq 3.5$. From the normalization parameter it is possible to determine the energy of the blast wave for various gases as a function of the pressure of the gases. In the gases He and H_2 a pronounced rise of the blast wave energy was found with rising pressure. However, in the gases N_2, Xe, and Ar there exists a maximum in the blast wave energy at a pressure of approximately 1 atm; a preliminary explanation is given. Author

N68-38365*# Techtran Corp., Glen Burnie, Md.
INVESTIGATION OF NON-CYLINDRICAL Z-PINCH IN CURRENTS ABOVE 1 MILLIAMPERE [ISSLEDOVANIYE NETSILINDRICHESKOGO Z-PINCHA PRI TOKAKH SVYSHE 1 MA]
V. I. Agafonov et al. Washington NASA Oct. 1968 15 p refs Transl. into ENGLISH of Intern. Atomic Energy Agency Paper No. CN-24/G-2, 1968 Presented at the 3d Conf. on Invest. in the Fields of Plasma Phys. and Controlled Thermonucl. Reactions, Novosibirsk, USSR, 1–7 Aug. 1968
(Contract NASw-1695)
(NASA-TT-F-11964; CN-24/G-2) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The results of studies of the dynamics of plasma focus and its associated emissions, carried out on an apparatus with a 66 cm anode and a condenser capacity of 576 microfarads, are summarized. The two-dimensional problem used to study the characteristic parameters of plasma focus is formulated. The basic experimental results are interpreted under the assumption of high-density plasma in the focus, heated to thermo-nuclear temperatures. Author

N68-38365# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOVEMENT OF A PLASMA STREAM THROUGH A NONUNIFORM TRANSVERSE MAGNETIC FIELD [RUKH STRUMENYA PLAZMY KRIZ NEODNORIDNE POPERECHNE MAGNITNE POLE]
K. D. Synelnykov et al. 6 Oct. 1967 9 p refs Transl. into ENGLISH Ukr. Fiz. Zh. (Kiev), v. 11, no. 8, 1966 p. 825–828
(FTD-HT-23-926-67; AD-674223) CFSTI: HC $3.00/MF $0.65

It is shown by using the equations of E. N. Parker that the motion of a plasma jet across a nonuniform magnetic field is decelerated if grad B is positive and is accelerated in decreasing fields. The equation for the square of the drift velocity, which is proportional to linear field changes, is given. This jet motion is one of the simplest effects in plasma physics. The theory holds that, depending on conditions, a plasma jet must move as a whole across the magnetic field with a magnetic field of nearly zero in the jet if temperature of two components of the jet is small compared to the jets kinetic energy of motion. Plasma jet behavior under real conditions is proved by numerous experiments to differ from theoretical in direction and speed. The present article shows that experimentally observed behavior of a plasma jet in a transverse gradient field is in absolute agreement with elementary plasma drift theory. The subject studied is a delimited plasma mass first moving at constant velocity in a uniform field and then encountering a gradient field with consequent drift. Basic assumptions of the calculations are that (1) plasma mass has magnetic moment and (2) speeds and field gradients fulfill the adiabatic law for ions and depend on the method of plasma generation. TAB

N68-38373# Sandia Corp., Albuquerque, N. Mex.
HIGH-FREQUENCY ELECTRICAL BREAKDOWN OF THERMALLY IONIZED GASES
A. J. Russo May 1968 62 p refs
(Contract AT(29-1)-789)
(SC-RR-68-284) CFSTI: HC $3.00/MF $0.65

An expression for the steady state ionization of a hot gas in the presence of a weak electric field is derived from statistical principles and is applied to air in the temperature range of 3000 to 5000°K. An alternate way of determining the breakdown field strength in cold gases by using the electron temperature as an indicator is investigated for air, neon, and helium. The electron temperature is calculated from the electron distribution function which is obtained by the solution of the linearized Boltzmann equation. Author (NSA)

N68-38423# Technische Hochschule Aachen (West Germany). Physikalisches Inst.
INTERACTIONS OF AN ELECTRIC ARC PLASMA WITH TRANSVERSE MAGNETIC FIELDS AND GAS FLOWS Final Scientific Summary Report, 1 Jun. 1964–30 Nov. 1967
Wilhelm Fucks, Klaus Bartels, Ernest Fischer, and Jurgen Uhlenbusch Wright-Patterson AFB, Ohio ARC Apr. 1968 79 p refs
(Contract AF 61(052)-806)
(HMP-118; ARL-68-0074; AD-674057)

Interactions of wall-stabilized and free burning arcs with transverse gas flows and magnetic fields perpendicular to the arc axis are studied. The arc plasma is described by the mono-fluid-approximation and the gas flow is assumed to be laminar, i.e. the Reynold-number of the flow is sufficiently small. Temperature distribution and flow in a wall-stabilized cylindrical arc are calculated, a transverse magnetic field giving rise to a double vortex and a displacement of the maximum of the arc temperature. For a free burning arc, analytical and numerical methods are developed to calculate the flow field for a given reasonable temperature field and the temperature distribution for a given flow field. For a given approximate temperature distribution the momentum equation is solved including inertial forces, viscous forces, and Lorentz forces. An analytic solution for a channel model is compared with more rigorous numerical calculations. It is shown that strong magnetic fields or inertial forces can cause a back-flow in the arc core. From the energy equation, the temperature distribution is calculated for a given homogeneous or inhomogeneous flow field. Assuming cylindrical symmetry the solution leads to an eigenvalue problem which determines the electric field strength in the arc depending on the flow parameters. The three-dimensional temperature distribution of an arc in a homogeneous flow is obtained prescribing suitable boundary conditions on the electrodes. Author (TAB)

N68-38458# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
THE EFFECT OF THE ELECTRODE GEOMETRY ON THE CURRENTS AND POTENTIALS IN MHD GENERATORS [EINFLUSS DER ELEKTRODENGEOMETRIE AUF STROEME UND SPANNUNGEN BEI MHD-GENERATOREN]
M. Selvat Feb. 1968 16 p refs In GERMAN; ENGLISH summary
(IPP-3/68) CFSTI: HC $3.00/MF $0.65

The effect of the electrode segmentation on the performance characteristics of MHD generators was found by means of simple physical considerations. Simple expressions are derived which give the efficiency of an MHD generator as a function of the geometry and the Hall parameter. Author

N68-38469# Westinghouse Research Labs., Pittsburgh, Pa. Atomic and Molecular Sciences.
BASIC PLASMA PROCESSES Technical Summary Report, 1 Jul. 1967–30 Jun. 1968
A. V. Phelps and C. L. Chen 30 Jun. 1968 43 p refs
(Contract Nonr-4725(00))
(Rept.-68-9E5-GASES-R1; AD-674120)

Measurements of the magnitude and wavelength dependence of the specular reflection of light in the vicinity of the cesium resonance lines from a cesium-sapphire interface verify the Taylor-Langmuir formula for the vapor pressure of cesium in the temperature range from 500 to 600K. This result eliminates the Cs density as a source of systematic error in our previous measurements of the self-broadening of the Cs resonance lines at 8521 and 8944A. Measurements have been made of the total amount of diffusely scattered resonance radiation for pure Cs and for Cs-nitrogen mixtures at Cs densities between 10 to the 14th power and 10 to the 16th power atom/cu cm. A preliminary analysis of this data shows that the method is capable of yielding quenching cross sections at high alkali vapor densities. Some features of the results, such as the apparent quenching caused by pure Cs, are not yet understood. Author (TAB)

N68-38500# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
TECHNICAL EXPERIENCE WITH ISAR 1 COLLECTOR
E. Breit and A. Knobloch Jun. 1968 13 p refs Presented at the 5th Symp. on Fusion Technol., Oxford, 2–5 Jul. 1968
(IPP-4/65) CFSTI: HC $3.00/MF $0.65

The design principles are briefly reported for the linear theta pinch Isar 1. Whereas the precollectors have been in operation now over three years without damage, the highly stressed main collector and the coils have been subject to some failures and have been modified. Operations began with 30 kV ringing duty shots (1.5 MJ) and in one and a half year there were no breakdowns. When raising the energy to 2.7 MJ the current carrying sheets were overstressed and it was necessary to increase the curvature radius at the coil feed edge. At the same time a collector extension was added and new coils were shaped to minimize return flux distortion of the magnetic field symmetry in the coil. When operating the system with 1.5 MJ and crowbar—which had also been installed in the meantime—the copper sheets at certain places in the coil and extension region were hammered out of the feed slot. The extension and coils were changed again for a solid steel version with welded copper contact bars which made possible the first 2.7 MJ crowbar shots. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-37444 Pennsylvania State Univ., University Park.
INTERFACIAL FREE ENERGIES IN COPPER AND COPPER-ZINC SOLID SOLUTIONS
Richard Allen Queeney (Ph.D. Thesis) 1967 67 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-3558

Intersections of coherent twin boundaries and high-angle grain boundaries in thin films of copper and copper-zinc alloys, the latter containing less than 30% zinc by weight, were examined in transmission electron microscopy. Photomicrographs of these intersections provided data which, in turn, gave the ratio of twin boundary Helmholtz free energy to grain boundary Helmholtz free energy. The electron microscopic techniques used included the correlation of diffraction patterns with coherent twin boundary directions to determine twin boundary and grain boundary plane orientations. In addition, the analysis of Kikuchi line diffraction patterns was utilized, whenever possible, to more accurately determine the orientation of the metal foil relative to the electron beam. The mean ratios of twin boundary free energy to grain boundary free energy were found to be 0.034, 0.032, 0.031, 0.029, and 0.023 for pure copper, copper-5% zinc, copper-10% zinc, copper-20% zinc, and copper-30% zinc, respectively. All measurements were taken on specimens quenched from 875°C. For a copper-30% zinc alloy, the mean ratio of twin boundary free energy to grain boundary free energy increased as annealing time increased. Dissert. Abstr.

N68-37448 Colorado Univ., Boulder.
GALVANOMAGNETIC EFFECTS OF n-InSb BELOW 1° K
Jerry Holmes Wilson (Ph.D. Thesis) 1967 57 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-15042

Some galvanomagnetic properties of n-type indium antimonide have been measured in the temperature range from four degrees Kelvin to 0.4 degrees Kelvin with donor concentrations between 2.6×10^{15} per cubic centimeter and 7.5×10^{13} per cubic centimeter. The electrical conductivity in zero magnetic field indicated the lack of freezeout for all donor concentrations measured. The transverse magnetoresistance of samples with donor concentrations of 7.5×10^{13} per cubic centimeter and 1.0×10^{14} per cubic centimeter showed a saturation in magnetic fields less than 10 kilo-oersteds provided the temperature was less than one degree Kelvin. At temperatures above one degree Kelvin, the saturation was not observed in any of the samples in magnetic fields up to 16 kilo-oersteds. An oscillatory behavior was observed in the transverse magnetoresistance of the sample with a donor concentration of 2.6×10^{15} per cubic centimeter. The saturation effect was interpreted by assuming a hydrogen molecule model of the impurities. The scattering mechanism in the magnetic field was taken to be predominantly due to neutral impurities. Longitudinal magnetoresistance was much smaller than the transverse magnetoresistance of samples with comparable impurity concentrations. Dissert. Abstr.

N68-37470 California Univ., Los Angeles.
THEORY OF THE MOTIONAL PROPERTIES OF SIMPLE IMPURITIES IN ALKALI HALIDE CRYSTALS
William Ronald Salzman (Ph.D. Thesis) 1967 210 p
Available from Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-3282

A theoretical model for the low lying motional states of substitutional impurities such as Li^+, CN^-, and OH^- in KCl is presented. The model is based on the assumption of a potential which has several equivalent minima with respect to rotational variables, center of mass displacement variables, or both. A set of pocket states is constructed, each of which describes the impurity localized within a single potential minimum. The barriers between the various minima are artificially very high to permit construction of localized pocket states. An appropriately defined barrier-lowering perturbation is introduced which reduces the barriers to their physical height. Linear combinations of the pocket states are taken which serve as bases of irreducible representations of the symmetry group of the potential, and their energies are computed by taking matrix elements of the barrier-lowering perturbation with these symmetrized functions. Dissert. Abstr.

N68-37485 Tulane Univ., New Orleans, La.
THE GROWTH OF LAMELLAR CRYSTALS OF COLLOIDAL GOLD
Ronald Gerry Peacock (Ph.D. Thesis) 1967 112 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-4051

The complete growth process of thin crystals of colloidal gold has been examined using transmission electron microscopy and electron diffraction. The crystals, which are grown from solution by chemical reduction, exhibit a hexagonal or trigonal symmetry and are about 100 Å thick and several microns in width. Crystals were extracted from the growth medium at regular intervals throughout the growth process and examined in the electron microscope. At room temperature the complete growth process requires approximately 240 hours. Of particular interest in the study was the nucleation and very early stages of the growth process. During the first few hours of growth very small nuclei of only several atomic layers in thickness form. Then a number of these coalesce to form a larger single crystal. Growth then continues in an atomistic manner. Dissert. Abstr.

N68-37490 Cornell Univ., Ithaca, N. Y.
FAR-INFRARED INTERFEROMETRY AND STRESS-INDUCED SHIFTS OF LATTICE RESONANT MODES
Ira Gehman Nolt (Ph.D. Thesis) 1967 161 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-3513

A far-infrared spectrometer has been constructed and used to study the vibrational spectra, from 3 to 100 cm^{-1}, of alkali halide crystals containing substitutional impurities. The f/1.5 instrument can be operated either as a grating monochromator or a lamellar grating interferometer and in both cases a double-pass optical system improves the performance. The interferogram is recorded in digital form, and a subsequent numerical Fourier transform yields the transmission spectrum. The effects of signal noise and various instrumental errors are discussed. The stress-induced frequency shifts of the lattice-resonant modes in KBr:Li^+ and KI:Ag^+ were studied in detail. Large frequency shifts are observed; for example, a uniaxial stress of 4 kg/mm^2 produces approximately a 15% change in the resonant mode frequency. These shifts for different stress and polarization directions reveal the defect symmetry to be cubic and provide a quantitative measure of the impurity-lattice coupling. Dissert. Abstr.

N68-37514# National Research Council of Canada, Ottawa (Ontario).
ELECTRON SPIN RESONANCE IN ALKALI HALIDE CRYSTALS CONTAINING SULFUR AND SELENIUM
A. Hausmann 1968 15 p 18 refs Transl. into ENGLISH from Z. Physik (Berlin), v. 192, 1966 p 313-328
(NRC-TT-1311)

The ESR of KCl and KBr single crystals doped with KSH or KSeH is investigated at low temperature. In these crystals interstitial hydrogen atoms are produced by irradiation with ultraviolet light at 20°K. After annealing to 110°K for some seconds and recooling to 20°K, the crystals show the resonance spectra of sulfur and selenium centers which are ascribed to S^-, H_2S^-, and Se^- ions. For verifying the nature of the centers crystals with KSD as well as KSH, the sulfur being enriched by S^{33} isotope, are studied. The components of the g and A tensors are determined. Two new types of sulfur centers are found in sulfide-doped crystals after introduction of F centers followed by irradiation with ultraviolet light at 370°K. Furthermore, all crystals being investigated reveal the ESR and HCN^- ions. Author

N68-37520 Duke Univ., Durham, N. C.
SECOND SOUND IN SOLID HELIUM 4
Clinton Craig Ackerman (Ph.D. Thesis) 1967 130 p
Available from Univ. Micrifilms: HC $6.20/Microfilm $3.00 Order No. 68-3411

This thesis presents the results of a preliminary experimental investigation of the behavior of heat pulses in He^4 crystals. Single crystals have been grown at a melting pressure of 54.2 atmospheres corresponding to a molar volume of 19.4 cc/mole. For temperatures between 1.4°K and 0.8°K ($T/\theta \geq .025$) thermal pulses traverse the sample in a diffusive mode with velocities inversely proportional to the umklapp relaxation time. From 0.8°K to 0.41°K, the lowest temperature attained, thermal pulses traverse the sample as second sound with velocities given approximately by $V_{II} = V_I/\sqrt{3}$, where V_I is calculated from Debye theory. This phenomena has been previously observed only in superfluid He^4. Up to three reflections of the first received thermal pulse were seen in the best crystals. The temperature dependence of the structure of the received second sound pulse is discussed in terms of the phonon-phonon collision mechanisms acting in the crystal. Dissert. Abstr.

N68-37529 Duke Univ., Durham, N. C.
THE SPECIFIC HEAT OF SEVERAL RARE EARTH GALLIUM GARNETS AT LOW TEMPERATURES
David Goodwin Onn (Ph.D. Thesis) 1967 179 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-2733

The specific heat of the gallium garnets of neodymium, samarium, erbium, holmium, dysprosium, gadolinium and ytterbium was measured between 0.35°K and 4.2°K. The shape of the specific heat anomaly was almost identical for all four transitions. The values of the critical entropies and internal energies indicated that the behavior of these compounds is best described by an isotropic Heisenberg magnetic model with spin 1/2. The transition in SmGaG and NdGaG may be attributed entirely to exchange interactions. In ErGaG dipolar effects may contribute up to 20 per cent of the specific heat at 4.2°K. The exchange constant was deduced for each compound by three methods which gave reasonable consistent results. Dissert. Abstr.

N68-37530 Iowa State Univ. of Science and Technology, Ames.
A STUDY OF THE F' CENTER IN SEVERAL ALKALI HALIDES
David Atherton Robinson (Ph.D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-2856

The F' band has been produced and measured in the following alkali halides: NaCl, KCl, KBr, KI, RbCl, RbI, CsBr, and CsI. The spectra consisted of a single main peak and either a shoulder or a distinct second peak to the high energy side of it. The main peak in NaCl had a symmetrical bell shape, whereas in the remainder of the salts it showed some structure. The potassium and rubidium salts showed a shoulder located on the high energy side of the main peak. The cesium halides showed a more complex structure. The structure in the main peak may be attributed to differences in band structure between the sodium halides and the other alkali halides. The shoulder, or second peak, to the high energy side of the main peak has been assigned tentatively to F' center absorption where the F center is left in an excited 2p state. A semicontinuum model variational calculation has also been carried out using a correlated Hylleraas wave function. Dissert. Abstr.

N68-37544 California Univ., Los Angeles.
THE ANALYSIS OF THE POLARIZED VIBRONIC SPECTRUM OF CESIUM URANIUM CHLORIDE AND THE ZEEMAN EFFECT OF CESIUM URANIUM CHLORIDE AND CESIUM URANIUM CHLORIDE BROMIDE
David Ross Johnston (Ph.D. Thesis) 1967 186 p
Available from Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-3267

The Zeeman effect has been observed for Cs_2UCl_6 and Cs_2UBr_6. Cs_2UBr_6 also has a very sharp line vibronic spectrum, and the site symmetry at the uranium site is found to be cubic although the space group symmetry is not yet known. Zeeman effect has been observed for both vibronic lines and pure electronic lines in both crystals. The g-values have been measured and compared to values calculated using the magnetic field as a perturbation on the intermediate coupling with the octahedral

potential The average percent deviation relative to the experimental g-values is 41%. It is found that Cs_2UBr_6 has vibronic selection rules for the Zeeman effect which are dependent on the direction of the magnetic field. The oscillator strengths for pure electronic magnetic dipole transitions have been measured and compared with calculated values. Dissert. Abstr.

N68-37551 Stanford Univ., Calif.
MICROWAVE OSCILLATIONS IN SEMICONDUCTING COMPOUNDS
Megha Shyam (Ph.D. Thesis) 1967 78 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17506

Experimental evidence is provided in support of the Ridley-Watkins electron transfer mechanism which is responsible for the Gunn effect. Two methods of varying the energy separation between the high and low mobility minima were employed to investigate the dependence of the threshold field on the energy separation in GaAs. In the first method, measurements were carried out using arsenic rich $GaAs_xP_{1-x}$ alloys. The normalized threshold field decreased monotonically from a value of unity in GaAs to 0.50 in an alloy with 48 percent phosphorus concentration. The second method used was the application of uniaxial stress; in this case the threshold field decreased rapidly for a stress applied along the (100) direction and more slowly for stress along the (110) and (111) directions. Uniaxial pressure techniques were employed in the investigation of InAs. Dissert. Abstr.

N68-37553 Virginia Univ., Charlottesville.
ACTIVE SITES FOR THE CATALYTIC DECOMPOSITION OF CARBON MONOXIDE ON NICKEL
Helen Eva Grenga (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17601

The catalytic decomposition of carbon monoxide on nickel was studied with particular interest in the identification of sites on the metal surface at which the catalytic reaction occurred. Monocrystalline metal thin films of (100), (110) and (111) orientations were prepared by vapor deposition onto heated rocksalt substrates. These films and monocrystalline bulk specimens were treated with carbon monoxide at 550°C and pressures ranging from 10^{-3} to 760 torr. The reacted films and shadowed extraction replicas of reacted films and bulk specimens were examined by transmission electron microscopy and electron diffraction. Graphite was the only solid reaction product found on (110) and (111) thin films and on bulk crystals, while a nickel carbide was observed on (100) thin films prior to graphite formation. Holes were found in (110) and (100) thin films, which had been treated with carbon monoxide at atmospheric pressure for several hours. These holes were attributed to the formation of nickel carbonyl at regions having a high chemical potential of nickel and/or carbon monoxide. Dissert. Abstr.

N68-37565 Washington Univ., Seattle.
ELECTRICAL RESISTIVITY OF METALLIC AND SEMI-METALLIC LIQUID ALLOYS
John Lashier Tomlinson (Ph.D. Thesis) 1967 160 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-3885

The electrical resistivity of In-Sb, In-Bi, Cd-Bi, Cd-Sn, Cd-Pb, Sn-Bi, and Au-Te liquid alloys was measured using an electrodeless, high frequency technique in which the resistivity is calculated from the measured change in Q when a liquid metal sample is inserted into a solenoid. The electrodeless resistivity measuring technique, previously described for use with semiconductors, was improved and extended for use with liquid metals. The results of the resistivity measurements led to the conclusion that all of the systems measured with the exception of Au-Te were typically metallic liquids as evidenced by positive temperature coefficients of resistivity and the absence of sharp peaks in the resistivity-composition curves. For Au-Te a negative temperature coefficient of resistivity and a sharp decrease in resistivity upon addition of Au to pure Te were observed. This system was defined as semi-metallic and compared with Cd-Sb and Mg-Bi. A model describing electrical resistivity in terms of scattering by density and composition fluctuations was modified and extended to non-regular solutions. Dissert. Abstr.

N68-37575 Northwestern Univ., Evanston, Ill.
FREE CARRIER REFLECTIVITY OF GRAY TIN SINGLE CRYSTALS
Robert John Wagner (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-3234

A study has been made of the free carrier reflectivity of gray tin single crystals between the temperatures of 25 and 273°K and the wavelengths of 13 and 220 microns. A variety of techniques has been used to obtain either the complete free carrier reflectivity structure or only the wavelength of the reflectivity minimum. Electrical conductivity and Hall coefficient measurements were then performed in order to obtain carrier concentration and mobility. Substituting these results along with the reflectivity data into the theoretical expressions for the optical constants, carrier effective masses were determined. Various expressions for effective mass were used depending on the particular gray tin sample under study and on the optical wavelengths at which the free carrier structure occurred. These calculations yielded a Γ_8^- + hole effective mass of $0.26m_e$ for samples $1.5 \times 10^{17}\ cm^{-3} \leq N_A - N_D \leq 3.1 \times 10^{19}\ cm^{-3}$ Dissert. Abstr.

N68-37624 Tulane Univ., New Orleans, La.
LATTICE DYNAMICS OF LITHIUM HYDRIDE
Joseph Larry Verble (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-4072

Lattice vibrations in crystalline lithium hydride were studied by measuring the phonon dispersion curves along the three high symmetry directions in a single crystal of ^7LiD, using the techniques of coherent inelastic scattering of thermal neutrons. The experimental dispersion curves were least-squares fitted to several versions of the point ion and shell models of lattice dynamics. A seven parameter shell model fit the data to within the experimental accuracy. The model indicates that the negative-negative ion interactions are about 7% of the positive-negative ion interactions. In addition, the bond in ^7LiD is found to be about 88% ionic, and in good agreement with estimates obtained from electronegativity considerations. From the best fit model, the dispersion curves of ^7LiH were calculated assuming that the forces were identical to those for ^7LiD. To simplify the application of the various models and to aid in classifying the dispersion curve branches, group theory was applied to the problem of lattice vibrations in the sodium chloride structure. Dissert. Abstr.

N68-37626 California Univ., San Diego.
THE MELTING CURVE OF HELIUM 3
Carl Robert Zeisse (Ph.D. Thesis) 1967 84 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-3249

Experimental and theoretical determinations of the exchange interaction in solid Helium 3 are reviewed, and an apparatus is described which was used to measure the Helium 3 melting curve to 12 m°K. For 12 m°K $\leq T \leq$ 600 m°K, the melting curve data is described by the relationship: $P = 29.107 + 0.25537\ (t)^2 - 0.05700\ (t)^3 + 0.01625\ (t)^4$ atm. Using the Clausius Clapeyron equation along with previous experimental measurements of the liquid and solid molar volumes and the liquid entropy, the data show that $S_{solid} = R \ln 2$ at 12 m°K. The

error in this determination is ±16%, putting an upper limit of 3 m°K on the exchange interaction. The Helium 4 melting curve was also measured below 300 m°K and found to be flat to within the pressure noise of ± 0.02 atm. Dissert. Abstr.

N68-37674# Uppsala Univ. (Sweden). Inst. of Physics.
PARAMAGNETIC CENTERS IN TIN-DOPED GALLIUM PHOSPHIDE
J. Brizz, S. Haraldson and C.-G. Ribbing Apr. 1968 16 p 15 refs
(UUIP-582)

Electron-spin-resonance measurements at 77 and 4.2°K on Sn-doped GaP crystals are reported. Fe^{3+} impurities were identified from a 5-line spectrum with g = 2.023 and crystalline field splitting parameter a = 389 × 10^{-4} cm^{-1}. Furthermore two strong isotropic lines with g = 1.998 and g = 2.130 were detected. The first line is attributed to an Sn donor, and the possible causes of the second one are discussed. Author (NSA)

N68-37728*# University of Southern Calif., Los Angeles. Dept. of Materials Science and Electrical Engineering.
LOCALIZED VIBRATIONAL MODES OF LITHIUM AND LITHIUM-DEFECT PAIRS IN SILICON Final Report, 1 Jul. 1967–30 Sep. 1968
William G. Spitzer 30 Sep. 1968 72 p refs
(Grant NGR-05-018-083)
(NASA-CR-97309; USCEE-304) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Reviewed are results of continuing studies on: (1) the localized vibrational mode of lithium diffused, undoped silicon; (2) the infrared absorption of electron irradiated, lithium diffused silicon; (3) localized vibrational mode absorption of lithium and phosphorus impurities in germanium; (4) lithium-boron defect pairs in $Si_{1-x}Ge_x$ alloys; (5) localized vibrational modes of substitutional defect pairs in silicon and lithium induced donor precipitation; and (6) one- and two-phonon optical absorption from boron impurities in silicon. Also cited are publications and papers. S.C.W.

N68-37772*# Stanford Univ., Calif. Solid-State Electronics Labs.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, 1 Jul.–30 Sep. 1968
Gerald L. Pearson 30 Sep. 1968 19 p 13 refs
(Grant NsG-555)
(NASA-CR-97357) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Extensive testing was conducted at elevated temperatures on a Schottky barrier diode, fabricated from previously grown Sn-doped GaP substrate with a chromium barrier and nickel-germanium layer. Dynamic and static measurements were taken and results show that operation at 500°C appears feasible. Beryllium doping in liquid epitaxial GaP was studied. It was concluded that Be was not a suitable dopant, primarily because it is a fast diffusant. Shallow donors, S, Se, and Te were diffused into GaAs to determine solubility and diffusion parameters. Results indicate that although there is significant out-diffusion, the electron concentration is still 4 to 5 times the intrinsic carrier concentration at 1000°C, and even more at 900°C (the temperatures of the two experiments comparing diffusion in undoped and heavily doped crystals). Out-diffusion and presumably in-diffusion of the Te is more rapid under the higher arsenic pressure. B.P.

N68-37791 Illinois Univ., Urbana. Materials Research Lab.
SCIENCE OF MATERIALS Annual Progress Report
15 Apr. 1968 74 p refs
(Contract AT(11-1)-1198)
(COO-1198-534)

Structure of materials, solid state physics, and energetic particle interaction are reviewed. The results include studies of self-diffusion of Ni in Ni–Co alloys showing that stacking faults provide paths of enhanced diffusion in these crystals. High purity niobium crystals were grown in a vacuum of 10^{-10} torr. A theory of composite martensite which accounts satisfactorily for the "225" and "259" habits in steels was generalized to describe martensite plates with other habits. Nuclear magnetic resonance studies of impurities in aluminum were reported. A general treatment was given of the thermodynamic properties of crystals containing defects. Single crystals of helium were grown at pressures as high as 1000 atm. Lattice constant and thermal expansion measurements were made on ^{20}Ne and ^{22}Ne crystals. A study of the spin-flip conduction electron scattering from impurities in liquid metals was made. Koehler's radiation damage group established that interstitial atoms in gold are mobile at 130°C. NSA

N68-37850# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SIMPLE DEFECTS IN GERMANIUM CREATED BY HIGH ENERGY ELECTRONS [DEFEKTY PROSTE W GERMANIE WYTWARZANE ELEKTRONAMI WYSOKOENERGETYCZNYMI]
Henryk Rzewuski 1968 64 p 28 refs In POLISH
(INR-890)

The properties of simple defects in the crystal lattice of n-type germanium created by 1-MeV electrons from the Van de Graaff electrostatic accelerators using dc and pulsed beams were investigated. In particular, fast processes of metastable defect annealing and their temperature dependence were analyzed by the method of concentrational annealing, and the charge state of simple defects above the annealing threshold of metastable defects was studied by the method of Hall mobility annealing. The measurements were carried out in the temperature range from 80 to about 200°K. It was found that for antimony-doped germanium in the temperature range from 100 to 120°K a process of fast annealing of metastable defects takes place. The activation energy E_R = 0.140 eV for this process differs considerably from the energy expected in the present model by MacKay and Klontz. A proposed new model of metastable defects based on the properties of doubly charged centers takes these results into account. By studying the charge state of simple defects with the method of isochronal annealing of Hall mobility, two new annealing thresholds at T_1 = 100°K and T_2 = 140°K were observed. The main annealing threshold at T_2 = 140°K is connected with the process of rearrangement of simple defects. In this process the transition from one doubly charged center to two singly charged centers takes place. This indicates that the defect centers in the investigated temperature region /T < 140°K/ are doubly charged centers. Author (NSA)

N68-37863# Hungarian Academy of Sciences, Budapest. Kozponti Fizikai Kutato Intezete.
CU63 NMR IN ELASTICALLY DEFORMED COPPER FOILS
K. Tompa, F. Toth, and E. Nagy 11 Jun. 1968 8 p 16 refs
(KFKI-16/1968)

The ^{63}Cu NMR spectrum parameters are, within the experimental accuracy, the same for the undeformed as for the samples stretched in the ⟨100⟩av direction up to the elastic limit. The data were taken on a copper foil of cubic texture, characterized by an average deviation of about 6.5 degrees. Results, together with the application of the Sholl theory of the quadrupole effect in metals, give an upper limit for the antishielding of factor $(1-\gamma_\infty)$. Author (NSA)

N68-37865# Kansas Univ., Lawrence.
CRYSTAL FIELD EFFECTS ON F CENTER WAVE FUNCTIONS IN KCl, CaF, AND MgO

Lyle H. Taylor and Robert J. Friauf Jun. 1968 4 p 3 refs Presented at Intern. Symp. on Color Centers in Alkali Halides, Rome, 23–27 Sep. 1968
(Contract AT(11-1)-1197)
(COO-1197-31; CONF-680902-1) CFSTI: HC $3.00/MF $0.65

Investigations of the interaction between an F-center electron and the core electrons of neighboring ions in the crystal are reported. A pseudopotential is obtained for each ion from free ion wave functions, and the superposition of potentials is expanded around the vacancy in Kubic harmonics. Numerical wave functions are obtained for the spherical part of the expansion, and the crystal field effects of the first nonspherical terms are obtained by perturbation theory to first order in wave functions and third order in energy. NSA

N68-37896# Library of Congress, Washington, D.C. Aerospace Technology Div.
BINARY AND TERNARY GALLIUM AND INDIUM CHALCOGENIDE SYSTEMS. PART 3: TERNARY SYSTEMS WITH A 1, 2, 3, OR 4 GROUP ELEMENT
John Kourilo *In its* Foreign Sci. Bull., Vol. 4, No. 9 Sep. 1968 p 39–52 27 refs (See N68-37893 24-23)

Current trends and achievements of Soviet and East European research are discussed in relation to the Soviet theory of crystallochemical analogy and isoelectronic series of inorganic complex phase semiconductor materials. The studies are singled out of the phase diagrams, crystal structure, optical and electrical properties of the homogeneous semiconducting ternary solid solutions and compounds to reveal the nature of the chemical bond and the energy band structure of the materials within the ternary systems. Phases with a relatively wide forbidden energy gap, or practically interesting photoluminescent and photoconducting properties were detected and described in the ternary systems studied. The $AgGaTe_2$ and $AgInTe_2$ compound semiconductors with a normal tetrahedral lattice were cited as prospective materials for IR image translators. The role was stressed for stoichiometric lattice vacancies and other defects in determining semiconducting characteristics of the ternary phases. Author

N68-37910# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
KINETICS OF THE PHOTOLUMINESCENCE OF CRYSTAL PHOSPHORS
V. V. Antonov-Romanovskii Oct. 1967 427 p refs Transl. into ENGLISH from Kinetika Fotolyuminestsentsii Kristallofosforov (USSR), 1966 p 1–324
(FTD-HT-67-492; AD-674713)

The luminescence kinetics of crystallophosphors for the case of photoexcitation have been discussed in the book. The case in which the electron and hole traps of the phosphor differ in the main only in depth has been discussed in detail. This has enabled the problem of extinction, stimulation and stationery luminescence be practically completely resolved under conditions corresponding to the majority of real cases, where the concentrations of free electrons and holes are negligibly small compared with the concentrations of the localized charges, where the recombination probability is small compared with the retrapping probability and where a saturation effect is absent. The luminescence methods of determining different parameters, particularly kinetic, which play the main part in the mechanism of phosphorescence, have been discussed in very great detail. A detailed description of the diffusion theory of phosphorescence has been given for the first time. TAB

N68-37916# Japan Atomic Energy Research Inst., Tokyo.
PROPERTIES AND STRUCTURES OF URANIUM OXIDES WITH EMPHASIS ON NONSTOICHIOMETRY
Tamotsu Ishii and Keiji Naito 1968 30 p 25 refs In JAPANESE; ENGLISH summary
(JAERI-4045)

There are many kinds of uranium oxide phases, UO_2, U_4O_9, U_3O_7, U_5O_{13} (or U_2O_5 or U_8O_{21}), U_3O_8 and UO_3 with wide ranges of nonstoichiometry. Reported experimental data concerning phase equilibria, thermochemical properties, crystal structures, phase transitions and electrical properties are summarized and assessed chiefly from the view point of nonstoichiometry. Particular emphasis was placed on the phase boundaries and equilibrium pressures of oxygen in the phase diagram, variation of thermodynamic functions in a range approaching to $UO_{2.00}$, crystal structures, and electric conductivity mechanisms. Electrical properties of uranium oxides, which depend on temperature and O/U composition, were investigated and the conduction mechanism was discussed from the experimental results. The nature and mechanism of phase transitions in U_4O_9 and U_3O_8 are discussed. Author (NSA)

N68-37969 California Univ., Berkeley.
RELAXATIONS IN A MOLECULAR CRYSTAL. THE FERMI MOMENTUM OF ALUMINUM FROM 0 TO 100 KILOBARS
James Joseph Burton (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-38

Properties of imperfect lattices of monatomic face centered cubic crystals are examined theoretically. The atomic interactions are represented by pair-wise additive potentials. The configuration of the atoms near each imperfection are obtained. The effects of relaxations on the energies of the defects are examined. For bulk defects–vacancies, divacancies, substitutional atoms, and substitutional atom-vacancy pairs–the relaxations are small and only slightly alter the energy of the defect. The Fermi momentum of aluminum is studied from 0 to 100 kilobars pressure. Bridgman anvils were used to generate the pressure and the position annihilation spectrum was studied at five pressures. The Fermi momenta are obtained from the positron annihilation spectra. The experimental values of the Fermi momenta of aluminum are in excellent agreement with the prediction of the free electron model. Dissert. Abstr.

N68-37985# Technische Hochschule Hannover (West Germany).
ELECTRICAL CONDUCTIVITY AND THERMOELECTRIC FORCE OF PURE AND CARBON MONOXIDE-COATED NICKEL FILMS [ELEKTRISCHE LEITFAEHIGKEIT UND THERMOKRAFT REINER UND MIT KOHLENMONOXIDE BELEGTER NICKELFILME]
Herbert Wenzel (Ph.D. Thesis) 1968 76 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Studied were effects of gas adsorption and film thickness on the thermodynamic properties of thin nickel films exposed to carbon monoxide. Electric resistance measurements at room temperature on vapor deposited nickel films of 15Å to 675Å thickness in a carbon monoxide atmosphere confirmed the correlation between film thickness, temperature, and resistance coefficients. Adsorption of carbon monoxide changed the electron concentration and electron energy and resulted in a 90% resistance change for medium thick films. Transl. by G.G.

N68-37998# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENERGY DISTRIBUTION MONOPHONON SCATTERING OF NEUTRONS IN CRYSTALS
V. N. Kashcheev 12 Mar. 1968 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 4, 1966 p 25–33
(FTD-MT-24-8-68; AD-674712) CFSTI: HC $3.00/MF $0.65

The jumps are established for the first three moments of energy distribution of the one-phonon coherent scattering of neutrons in a ferromagnet at the Curi point. The value of each jump is found to be proportional to that of the jump of the spin heat capacity. Author (TAB)

N68-38032# Michigan Univ., Ann Arbor. Dept. of Geology and Mineralogy.
STUDY OF POLYTYPIC PHASE RELATIONS AMONG COMPLEX INORGANIC STRUCTURES Semiannual Report, 1 Nov. 1967–30 Apr. 1968
Donald R. Peacor Jul. 1968 12 p refs
(Contract DA-28-043-AMC-01338(E))
(ECOM-01338-6; Rept.-6; AD-674662) CFSTI: HC $3.00/MF $0.65

The structure of diaboleite, a derivative of that of perovskite, has been confirmed. Progress on the complete determination of the hematophanite structure, also a derivative of that of perovskite, is reviewed, and some general relations among these structure types is described. Further definition of the structures of plumboferrite and nigerite is reviewed. The initial phases of work on single crystal polytypes at high temperature, in this case Wollastonite, showed no tendency for disappearance of superstructure or transformation to the assumed more stable phase. Author (TAB)

N68-38080# Wayne State Univ., Detroit, Mich. Dept. of Physics.
ELECTRON PARAMAGNETIC RESONANCE STUDIES OF RADIATION EFFECTS IN SOLIDS AND CHEMICAL COMPOUNDS Technical Progress Report, 1 Jun.–31 May 1968
Yeong Wook Kim 31 May 1968 26 p
(Contract AT(11-1)-1054)
(COO-1054-32) CFSTI: HC $3.00/MF $0.65

Investigations were made on the following three groups of materials: (1) alkali metal halides, (2) phosphorus materials, and (3) superconducting materials. The samples employed in the first two groups were in the form of single crystals, while those for the third group were thin films. The samples were irradiated in beams of x rays, electrons, gamma rays, and neutrons for varying dosage at temperatures controlled near 300 or 77°K. Results are summarized. NSA

N68-38100# McGill Univ., Montreal (Quebec). Magnet Lab.
MULTIMAGNON ABSORPTION IN MNF2-OPTICAL ABSORPTION SPECTRUM
Richard Stevenson and Marvin M. Shapiro 21 Jun. 1968 20 p
(Contract Nonr-3013(00))
(TR-11; AD-674866) CFSTI: HC $3.00/MF $0.65

The absorption spectrum of MnF2 at 4.2K in the 3900A region was measured in zero external fields and in high fields. Exciton lines with magnon sidebands are observed, accompanied by a large number of weak satellite lines. Results on the exciton and magnon absorptions are similar to those of McClure et al. The satellite lines are interpreted as being multi-magnon absorptions, and it is possible to fit the energy of all the absorptions with magnon energy data. One intense line classified as a four magnon absorption appears to show the expected magnetic field behaviour. The same method of classification is used to classify all the subsidiary lines in the 5400A region observed previously by Sell. Author (TAB)

N68-38106# London Univ. (England).
CALCULATION OF PHYSICAL PROPERTIES OF CO-OPERATIVE ASSEMBLIES Final Technical Report, Mar. 1967–Feb. 1968
C. Domb May 1968 76 p refs
(Contract DAJA37-67-C-0365)
(AD-674642) CFSTI: HC $3.00/MF $0.65

The aim of this research is to study the critical behavior of systems which undergo discontinuous phase transitions. The critical behavior of the Ising Model above and below the critical temperature with an investigation of the susceptibility and its higher derivatives is reported. The specific heat of the Ising Model below the critical temperature is investigated and a representation constructed. Theoretical work on the anisotropic classical Heisenberg Model is reported. A second aim of this research is to study the configurational properties of polymer chains using the self-avoiding walk model. An evaluation of the second virial coefficient of a polymer solution is undertaken and its dependence on chain length assessed. Author (TAB)

N68-38119# Technische Hochschule Hannover (West Germany).
ELECTRICAL CONDUCTIVITY AND PHOTOELECTRIC BEHAVIOR OF THIN NICKEL FILMS [ELEKTRISCHE LEITFAEHIGKEIT UND PHOTOELEKTRISCHES VERHALTEN DUENNER NICKELFILME]
Christian Woelfing (Ph.D. Thesis) 1967 84 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Electrical resistance and the photoelectric properties of vapor-deposited nickel films in the thickness range from 30 Å to 800 Å were investigated as functions of temperature during measurement and annealing temperature of the film. The nickel films had the normal conductive characteristics of metals within the investigated range. The effects of annealing on the resistance were found to agree with the established principle, i.e., conductivity of metals depends strongly on lattice defects. An exception were the layers with thicknesses between 30 Å and 40 Å, where a negative resistance-temperature coefficient was observed in case of very low annealing temperatures. The specific resistances of the films were found to depend on the thickness of the layer. Measured photoelectric properties were evaluated according to the theory of Fowler. The dependence of the mass constant on the thickness of the layer is attributed primarily to the absorption of light. Transl. by K.W.

N68-38148# National Bureau of Standards, Washington, D. C.
MEASUREMENT OF CARRIER LIFETIME IN SEMICONDUCTORS: AN ANNOTATED BIBLIOGRAPHY COVERING THE PERIOD 1949–1967 Final Report, 1 Dec. 1966–1 Jan. 1968
W. Murray Bullis Wright-Patterson AFB, Ohio AF Mater. Lab. Jun. 1968 70 p
(NBS-TN-465; AFML-TR-68-108; AD-674627) CFSTI: HC $3.00/MF $0.65

About 300 papers concerned with the measurement and interpretation of carrier lifetime in semiconductors are listed together with key words and a brief comment for each. Eight types of papers are included: Description of Methods, Analysis of Results, Standard Methods, Experimental Results, Theoretical Models, Auxiliary Procedures and Data, Reviews, and Books. Emphasis is placed on methods of carrying out measurements of carrier lifetime. Hence complete coverage was attempted and nearly two thirds of the entries appear in the first three categories. A large fraction of the papers listed describe the photoconductivity or photoconductive decay methods. The other most popular methods are based on diode characteristics or the photomagnetoelectric effect. In all, 35 methods for measuring carrier lifetime are represented by entries. In addition, representative papers which describe various models for recombination are included together with a number of papers which discuss the influence of surface recombination and trapping phenomena. Auxiliary procedures such as surface preparation, formation of ohmic contacts, control of temperature, and the like are described in some of the entries. Two indexes: a Key Word Index and an Author Index, are provided together with a classification of the various methods for measuring carrier lifetime. Author (TAB)

N68-38158# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF THE PHYSICS OF SEMICONDUCTOR DEVICES
Ya. A. Fedotov 9 Jan. 1968 607 p refs Transl. of the book "Osnovy Fiziki Poluprovodnikovykh Priborov" Moscow, Izd. Sov. Radio, 1964 p 1–655
(FTD-HT-67-194; AD-673918) CFSTI: HC $3.00/MF $0.65

The monograph examines physical processes in semiconductor devices which determine their parameters and characteristics, peculiarities of circuit application, stability of parameters of semiconductor devices, and their reliability. A short description of the principle electrophysical properties of semiconductor materials is given along with basic information about the construction and technology of semiconductor devices and perspectives for the development of semiconductor technology. TAB

N68-38201*# Techtran Corp., Glen Burnie, Md.
MOBILITY OF ATOMS ON A CRYSTAL SURFACE AT THE MELTING POINT [O PODVIZHNOSTI ATOMOV PO POVERKHNOSTI KRISTALLA PRI TEMPERATURE PLAVLENIYA]
V. I. Shimulis et al Washington NASA Oct. 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 137, no. 3, 1961 p 648–651
(Contract NASw-1695)
(NASA-TT-F-11773) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The degree of mobility of atoms on crystal surfaces at the melting point is investigated with consideration of the entropy of the two-dimensional forward motion of adsorbate molecules. Equations are given for entropy changes during transition. The crystal structures of certain metals at the melting point are discussed. It is possible to predict crystal structure at the melting point if the melting point, heat of sublimation, and dependence of heat capacity on temperature to the melting point are known. Author

N68-38208# Illinois Univ. Urbana. Physics Dept.
DIFFUSION OF LATTICE DEFECTS IN A STRESS FIELD
J. S. Koehler Sep. 1968 13 p refs
(Contract Nonr-1834(26))
(AD-674522) CFSTI: HC $3.00/MF $0.65

The object of this note is to clarify the discussion concerning diffusion of point defects in a stress field. There are two effects; one (the Einstein term) is associated with changes in the equilibrium defect energy with position; another (the barrier term) results because stress fields can alter the height of the activation barrier. Both effects are important. Author (TAB)

N68-38226# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS OF PHYSICS OF THIN FILMS [NEKOTORYE PROBLEMY FIZIKI TONKIKH PLENOK]
N. G. Nakhodkin 9 Nov. 1967 29 p refs Transl. into ENGLISH from Akad. Nauk Ukr. Fiz. Metallicheskikh Plenok (Kiev), 1965 p 4–39
(FTD-MT-24-261-67; AD-674688) CFSTI: HC $3.00/MF $0.65

This is a review article dealing with the present state of the art in the production of thin films (10-1000 A thick) and the study of their physical properties. The subjects covered are: (1) Control of the growth and crystallization of films to obtain prescribed structure and dimensions, including the influence of factors such as condensation and crystallization centers, substrate temperature, impurities and adsorbed gases, catalytic processes, and the effect of electrons and other particles. (2) Problems in the kinetics of electrons in thin films (electric conductivity of thin films and the size effect, electric conductivity of superthin films, metal/dielectric film systems, and possible use of polymer materials in film electronics). TAB

N68-38259# California Univ., Berkeley. Electronics Research Lab.
ELECTROMAGNETIC WAVE-CHARGE INTERACTION IN CROSSED FIELDS Quarterly Progress Report, 16 Feb.–15 May 1968
K. A. Fox, M. A. Meyer, S. Swierkowski, C. W. Turner, T. Van Duzer et al Aug. 1968 48 p refs
(Contract DAAB07-67-C-0227)
(ECOM-0227-4; QPR-4; Rept.-4; AD-674206) CFSTI: HC $3.00/MF $0.65

The purpose of the work on this contract is to investigate the interaction of electromagnetic waves and charge carriers in vacuum and solids. The construction of a crossed-field amplifier which will incorporate the results of our noise studies is in progress. Work on the crossed-field gun design method developed by R. A. Rao is being carried on to obtain designs for magnetically shielded guns. An experimental and theoretical evaluation of the crossed-field acoustic-wave amplifier is being conducted. Electromagnetic and space-charge waves in semiconductors are being studied in order to determine if there are microwave device applications. The effort during this quarter was devoted to trying to develop efficient means for interacting with the space-charge waves with energy from an external source. Author (TAB)

N68-38286# McGill Univ., Montreal (Quebec). Magnet Lab.
MULTI-MAGNON ABSORPTION IN MNF2.1. THE FAR INFRARED SPECTRUM
Marvin M. Shapiro and Richard Stevenson 21 Jun. 1968 28 p refs
(Contract Nonr-3013(00))
(TR-10; AD-674865) CFSTI: HC $3.00/MF $0.65

The far infrared absorption spectrum of a thin crystal of MnF2 at 4.2K and 80K was observed in the region 40/cm to 360/cm. The spectrum consists of many sharp lines superimposed on a broad background of phonon origin. The sharp lines are interpreted as being due to processes in which multi-magnons are created, sometimes accompanied by either the creation or absorption of standing elastic waves. At 4.2K, up to 6 magnons are created simultaneously. At 80K, multi-magnons are created in the ordered surface layers of the crystal with energies nearly identical to those of the 4.2K magnons. Weak bulk multi-magnons are also observed at 80K with appropriate lower energies. Author (TAB)

N68-38297# California Univ., Los Angeles. Physics Dept.
STUDY OF OPTICAL INTERACTIONS IN SOLIDS Semiannual Technical Summary Report, Period Ending 31 Mar. 1968
R. Braunstein May 1968 69 p refs
(Contract Nonr-233(93); ARPA Order 306; Proj. Defender)
(AD-673983) CFSTI: HC $3.00/MF $0.65

Multiphoton absorption in semiconductors was investigated with emphasis on the III-V compounds. It was shown that this mechanism can set an intrinsic upper limit to the power density transmittible through semiconductors. This mechanism is an effective means of optically pumping semiconductor lasers, can limit the power density obtainable from such devices, or can enable the fashioning of nonlinear optical elements. Laser action in a large volume of Ga As was excited by double-photon pumping using a Q-switched neodymium laser, yielding output power of the order of a megawatt/sq cm at 8365 A at liquid nitrogen temperature. A new temperature anomaly of the threshold for stimulated Raman emission in liquid benzene was discovered and investigated. This effect indicates that self-focusing of the exciting laser beam does not explain previously observed Raman thresholds. Author (TAB)

N68-38299# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC PROPERTIES OF THIN FERROMAGNETIC FILMS AND THE PERFORMANCE CURVES OF FILM ELEMENTS OF MEMORY MATRICES [MAGNITNYYE SVOYSTVA TONKIKH FERROMAGNITNYKH PLENOK I RABOCHIE KHARAKTERISTIKI PLENOCHNYKH ELEMENTOV MATRITS ZAPOMINAYUSHCHIKH USTROISTV]

G. P. Zharikov and Yu. V. Ostapenko 22 Sep. 1967 12 p refs Transl. into ENGLISH from the Publ. "Kiberneticheskaya Tekhnika" USSR, 1965 p 11–18
(FTD-HT-23-784-67; AD-673940) CFSTI: HC $3.00/MF $0.65

The development of magnetic film memories is impossible without investigations of the relationship of the performance curves of matrices to the magnetic properties of the elements and investigations of the patterns of variations in the geometric and technological parameters of the films. The direct aim of these investigations is the determination of the optimal magnetic properties of the films and the determination of their parameters. The present article investigates the dependence of the threshold characteristics of magnetic film elements of matrices on the coercive force of the shift domain boundaries H sub c, the uniaxial anisotropy field H sub k, and on the dispersion of the mean directions of film anisotropies. A study is made of the feasibility of optimizing the magnetic properties by the selection of films according to thickness and composition. TAB

N68-38300# California Univ., Los Angeles. Dept. of Engineering.
ANOMALOUS BEHAVIOUR OF THE ELASTIC CONSTANTS OF GADOLINIUM
Marshall Long, Jr. Jul. 1968 57 p refs
(Contract N00014-67-A-0111-0011)
(Rept.-68-30; AD-674520) CFSTI: HC $3.00/MF $0.65

The elastic constants C sub 33 and C sub 44 of single crystal gadolinium have been examined as a function of temperature (range: 77K to 330K) by means of an acoustical pulse-overlap technique. An anomaly in the elastic constant C sub 33 was seen whereby its value decreased about 2%, and then returned to normal. This anomaly occurred over a 30K temperature range with a minimum at about 222K. There was no evidence of such an effect in C sub 44. Magnetic fields of up to 12K Oe were applied either along the unique axis or in the basal plane which eliminated the effect. The origin of this anomaly is believed to lie with the change in spontaneous moment alignment which is coupled to the acoustic wave by means of a volume magnetostriction. Author (TAB)

N68-38342# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GALVANOMAGNETIC AND THERMOMAGNETIC PROPERTIES OF GALLIUM ARSENIDE AFTER DIFFUSION OF COPPER [GALVANOMAGNITYNE I TERMOMAGNITNYE SVOISTVA ARSENIDA GALLIYA POSLE DIFFUZII MEDI]
O. V. Yemel'yanenko, E. E. Klotyn'sh, and D. N. Nasledov 16 Nov. 1967 15 p refs Transl. into ENGLISH from Akad. LatSSR. Izv. Seri. Fiz. i Tekhn. Nauk, (USSR), no. 5, 1965 p 47–56
(FTD-HT-23-762-67; AD-673923) CFSTI: HC $3.00/MF $0.65

A method is elaborated for multiple diffusion of copper into gallium arsenide. It is shown that the concentrations of impurity ions and neutral atoms can be determined from the temperature dependance of Hall mobility. P-GaAs is investigated after one to three diffusions of copper with a whole concentration (at 300 degrees K) of 7.4 x 10 to the 14th power to 7.0 x 10 to the 15th power/cc. An acceptor level is detected at a depth of 0.14 plus or minus 0.01 ev. The carrier scattering mechanisms are analyzed on the basis of the temperature curves of mobility and the transverse Nernst-Ettingshausen effect. TAB

N68-38368# Universite Lovanium, Leopoldville (Congo).
CONTRIBUTION OF NUCLEAR MAGNETIC RESONANCE IN THE DETERMINATION OF CRYSTALLINE STRUCTURES. LOCALIZATION OF HYDROGEN ATOMS [CONTRIBUTION DE LA RESONANCE MAGNETIQUE NUCLEAIRE A LA DETERMINATION DES STRUCTURES CRISTALLINES. LOCALISATION DES ATOMES D'HYDROGENE]
Jean-Marie Dereppe 1967 170 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

The method of Pake, and its extension, the method of ΔH, and the method of moments were used to determine the nuclear magnetic resonance spectra of various hydrated crystalline compounds; and the relative merits of each method are noted. Operators are considered as functions of spin, magnetic interactions and their Hamiltonians are discussed, and calculation of the various spectra is detailed. Proton structure determination by the three methods is also described. Neutron diffraction and nuclear magnetic resonance methods based on interactions among magnetic moments provide a good approach to the localization of the hydrogen atoms in these crystals. Transl. by M.W.R.

N68-38463# Yale Univ., New Haven, Conn. Kline Geology Lab.
LIQUID METALS, RADIATION EFFECTS IN IONIC CRYSTALS, AND YIELDING STUDIES BY ULTRASONICS Final Report
Robert B. Gordon Aug. 1968 10 p refs
(Contract Nonr-609(35))
(AD-673968) CFSTI: HC $3.00/MF $0.65

Summaries are given of research projects which included: Ultrasonic measurements in Hg-Tl alloys; elastic modulus and internal friction measurements on alkali halide crystals after exposure to x-rays; internal friction measurements of the earliest stages of plastic deformation in steel and Mg; acoustic measurements of materials under high-pressure. TAB

N68-38480# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
CONSOLIDATED Semiannual Progress Report, 1 Oct. 1967–31 Mar. 1968
1968 214 p refs
(SAPR-7; AD-674031)

Contents: Solid state: Semiconductors; Quantum electrons and lasers; Magnetism; Defects in crystals; High field superconductivity; Metals; Applied electromagnetics and plasmas: Plasmas; Millimeter wave radiometry; Information sciences: Control systems; Communication and rader systems; Switching, automata theory, and computers; Biomedical engineering: Cardiovascular and respiratory systems; Fluid-electrolyte and renal systems; Nervous systems; Neuromuscular systems. TAB

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-37831*# Dynamic Science Corp., Monrovia, Calif.
HYPERGOLIC STREAM IMPINGEMENT PHENOMENA NITROGEN TETROXIDE/HYDRAZINE
B. R. Lawyer and B. P. Breen Oct. 1968 28 p 2 refs
(Contract NAS7-467)
(NASA-CR-72444) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Stream separation limits were experimentally determined for impinging liquid N_2O_4/N_2H_4 streams using both two-dimensional and circular jets. The two-dimensional apparatus allowed photographic observation of both the impingement point and the propellant spray from which separation was determined. A semi-empirical equation was developed which correlates the data and defines the mix/separate limit. All tests were run at atmospheric pressure and with a 60° impingement angle. Injector "popping" was found to occur when circular jets are operated in the mix regime at D/V values greater than approximately 0.1 milliseconds.

The "popping" appears to be associated with an intermittant ignition of mixed propellants in the impingement mixing zone. Based on the two-dimensional and circular jet test data, design curves were constructed which define the mix/separate/pop regimes for doublet injector elements in terms of the injection velocity, orifice diameter, and propellant inlet temperature. Author

N68-38278# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
RHEOLOGICAL EVALUATION OF EMULSIFIED JP-4 FUEL Final Report
Anthony J. Beardell, Stephen Blackwood, and Robert A. Keeler Ft. Eustis, Va. Army Aviation Mater. Labs. Jun. 1968 84 p ref
(Contract DAAJ02-67-C-0104)
(RMD-5127-F; USAAVLABS-TR-68-27; AD-674250) CFSTI: HC $3.00/MF $0.65

A study was made to characterize an emulsified JP-4 fuel which, if proven to be operational for jet engines, can greatly increase aircraft safety. The study includes the measurement of the rheological properties, namely, yield point and apparent viscosity, over a range of temperatures and as a function of mixing time and aging. The droplet diameter of the fuel before and after alteration (by additional mixing) and after aging was also established. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-37605*# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.
COMPILATION OF ROCKET SPIN DATA. VOLUME 3: DATA EVALUATION AND RECOMMENDATIONS Final Report, Nov. 1966–Aug. 1968
Leo J. Manda 23 Aug. 1968 92 p 16 refs
(Contract NAS1-6833)
(Rept.-3001-3) CFSTI: $3.00/MF $0.65 CSCL 21H

Test data compiled and analyzed during the Compilation of Rocket Spin Data program indicates that practically every propellant formulation variable and motor operating condition will influence the sensitivity of a composite solid propellant to a spin environment. The increase in burn rate noted with spin is shown to be a function of motor size, spin rate, grain configuration, and operating pressure; and also of aluminum (Al) particle size, ammonium perchlorate (AP) particle size, and type of binder. With qualitative data currently available regarding the effects of changes in Al or AP particle size, a research program to quantify the effects of different binders is recommended for immediate implementation. Additional recommendations include an analytical/experimental program to better define the effects of spin on motor gas dynamics and the usual reductions in nozzle efflux capability and gross deviations in end-burning motor performance attributed to the spinning gas flow. Author

N68-37845*# Hughes Research Labs., Malibu, Calif.
DISCHARGE CHAMBER STUDIES FOR MERCURY BOMBARDMENT ION THRUSTERS
W. Knauer, R. L. Poeschel, H. J. King and J. W. Ward Sep. 1968 137 p 16 refs
(Contract NAS3-9703)
(NASA-CR-72440) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Experimental and theoretical studies which were undertaken to achieve further optimizations of the Kaufman thruster discharge are reported. A SERT-II type thruster was used to establish performance standards. The thruster was operated with three cathode types: (1) a NASA magazine type oxide cathode, (2) an oxide coated nickel spiral cathode, and (3) a hollow cathode. In all performance tests, the thruster was operated for a sufficient time to establish stability in neutral propellant flow rates, equilibrium temperature of components, and cathode emission. The objective of the oxide cathode thruster studies was to investigate thruster performance by parameter variation and to gain a physical understanding of the changes in discharge plasma properties effected by favorable parameter modifications. The following studies were conducted on hollow cathode thrusters with the dual objectives of improving the understanding of the thruster discharge and optimizing performance: discharge operation; interface between hollow cathode and discharge plasma; and parametric and diagnostic studies of the discharge plasma. Performance tests of a discharge chamber with a predominantly radial magnetic field configuration were undertaken to determine whether the proposed design would significantly improve ion beam uniformity. Theoretical studies included analyses of basic properties of the Kaufman thruster discharge; discharge chamber theory; and scaling laws. Included are tables which provide the thruster parameters for the performance mappings and plasma diagnostics. S.C.W.

N68-38024* Marquardt Corp., Van Nuys, Calif.
ANALYSIS OF REDUCED FILM COOLING EFFECTS ON THE PERFORMANCE, IGNITION, AND THERMAL CHARACTERISTICS OF THE MARQUARDT APOLLO SM-LM RCS ENGINE
L. C. Southworth 30 Sep. 1968 96 p refs
(Contract NAS9-7281)
(NASA-CR-92363; S-894) CFSTI: $3.00 CSCL 21H

Existing and new TMC analytical capabilities were used in making the required analyses. Part of the new work included the development of two IBM 360/40 computer programs, a preigniter rocket engine hydraulic program and a steady state performance program. When used with existing capabilities, these programs provided a strong base from which comprehensive analyses of the effects of reduced film cooling could be made. Results of the analyses showed that in no cases would loss of performance result, and improved performance would be realized, for some fuel cooling flow configurations. The analyses also indicated that good ignition will occur in all cases. In addition, reduced film cooling will reduce the amount of fuel accumulated on chamber walls during pulsing operation with resulting reduction in combustion residue formation and subsequent ignition overpressures. Author

N68-38078# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
DESIGN AND EVALUATION OF A HIGH TEMPERATURE RADIAL TURBINE Quarterly Technical Summary Report No. 4, 1 May–31 Jul. 1968
G. S. Calvert 15 Aug. 1968 30 p
(Contract DAAJ02-68-C-0003)
(PWA-FR-2936; AD-674196) CFSTI: HC $3.00/MF $0.65

Radial turbines offer greater stage work capacity than axial turbines. If this advantage can be coupled with a capability of accommodating high turbine inlet temperatures, radial turbines will permit appreciable simplification of small gas turbine engines for use in future Army vehicles. The report discussed development of the technology for high temperature radial turbines to a level that will permit a potential small-engine manufacturer to make a choice between the radial and the axial turbine. Author (TAB)

N68-38079# Continental Aviation and Engineering Corp., Detroit, Mich.

EXPERIMENTAL INVESTIGATION OF LOW ASPECT RATIO AND TIP CLEARANCE ON TURBINE PERFORMANCE AND AERODYNAMIC DESIGN Summary Report

Roy Marshall and Rogo Casimer May 1968 107 p refs

(Contract DA-44-177-AMC-447(T))

(USAAVLABS-TR-67-80; Rept.-1043; AD-674201) CFSTI: HC $3.00/MF $0.65

The aerodynamics of any cooled turbine are compromised by mechanical design, fabrication techniques, heat transfer, and cooling restrictions. Additional requirements of high outputs out of small turbomachinery packages result in limitations on the turbine that are unique to low-airflow, high-pressure-ratio, small-category machines. These practical considerations limit the tip clearance, axial chord lengths, tolerances, and geometry. The resultant blading is usually of low-aspect-ratio type, and characteristically high secondary losses predominate. The report presents the aerothermodynamic design considerations of three turbine flowpaths, which were cold-flow tested to evaluate the performance effects of span aspect ratio and tip clearance on turbine efficiency. Complete maps were generated for the three configurations, and tip clearance effects were evaluated at design speed over a range of pressure ratios. Rotor blade aspect ratios were tested from 0.41 to 1.26, and blade heights varied from 0.36 inch to 1.09 inches. Rotor tip clearance was varied from 1.5 to 5.0 percent of the blade span. Results of the investigation suggest that predominance of high secondary losses should allow a design with high-aspect-ratio blading and low wheel speeds to produce the same performance as low-aspect-ratio blading with high rim speeds. Author (TAB)

N68-38270# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TEMPERATURE ERRORS IN MEASURING THE DIAMETER OF THE ROTOR OF A COMPRESSOR AND A GAS TURBINE ENGINE [TEMPERATURNYE POGRESHNOSTI IZMERENIYA DIAMETRA KOLES ROTORA KOMPRESSORA I TURBINY GTD]

I. E. Velikovskii 17 Nov. 1967 10 p refs Transl. into ENGLISH from Kazan. Aviats. Inst. Tr., no. 84, 1964 p 15-22

(FTD-HT-23-992-67; AD-673924) CFSTI: HC $3.00/MF $0.65

The error caused by thermal expansion of rotor wheels in gas turbines during length measurements is investigated. To account for the differential expansion of the various blade and wheel elements of the rotor, a compound expansion coefficient is derived. It is shown that to minimize thermal expansion errors the measuring instrument and the turbine rotor must reach thermal equilibrium and that a composite measuring scale with an effective expansion coefficient equal to alpha pr of the rotor should be used. Curves are given showing error versus rotor length for different delta alphas between the rotor and the measuring scale. Author (TAB)

N68-38292# Continental Aviation and Engineering Corp., Detroit, Mich.

ENVIRONMENTAL TESTING OF A GAS TURBINE ENGINE UTILIZING EF4-101 EMULSIFIED JP-4 FUEL Final Technical Report

Thomas Harvey and John Monarch Aug. 1968 57 p

(Contract DA-44-177-AMC-460(T))

(CAE-1098; USAAVLABS-TR-68-55; AD-674205) CFSTI: HC $3.00/MF $0.65

The report presents the results of laboratory, environmental, and endurance testing directed toward the determination of the effect of direct burning of emulsified JP-4 fuel in a gas turbine engine and the handling and pumping of emulsified JP-4 fuel. Engine operation, including starting and transient operation, with EF4-101 emulsified fuel was essentially the same as that with liquid JP-4 fuel during all phases of testing. Engine testing was terminated when a hot section corrosion problem, generated by one of the additives in the emulsified fuel, was encountered. The use of emulsified fuel will require a new technology in the design of fuel filters, fuel pumps, fuel flow measuring devices, and fuel handling practices. Author (TAB)

N68-38293*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

LIQUID PROPELLANT THERMAL CONDITIONING SYSTEM Final Report

W. H. Sterbentz 15 Aug. 1968 141 p refs

(Contract NAS3-7942)

(NASA-CR-72365; LMSC-K-07-68-2) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Details are presented on the system design and the testing of the thermal conditioning unit which maintains tank pressure control through extraction of either liquid or gaseous hydrogen and through utilization of the heat transport properties of the extracted fluid. Among the conclusions are the following: The lightweight unit controls the pressure level of a full-scale liquid hydrogen tank efficiently and is equally effective in gas or liquid hydrogen. The unit controls the tank pressure effectively and with no discernible differences whether its mixer unit discharges in the direction of the one-g gravitational force or perpendicular to it. Performance of the individual components was very close to their design performance. The overall performance of the unit is approximately predicted by a quasi steady state thermodynamic theory based upon a nonstratified propellant within the tank. The test results indicate that tank pressure control is basically governed by the rate of heat transfer within the heat exchanger. Since the heat exchanger is force convection dominated, the thermal conditioning system is expected to perform in zero gravity as it did in one gravity. Author

N68-38298# Naval Air Turbine Test Station, Trenton, N. J. Aeronautical Turbine Dept.

INVESTIGATION OF VITIATED INLET-AIR EFFECTS ON TURBOJET ENGINE PERFORMANCE

Daniel R. Snyder Jul. 1968 35 p refs

(NAPTC-ATD-152; AD-673985) CFSTI: HC $3.00/MF $0.65

Laboratory test were conducted to investigate the effects of vitiated inlet-air on turbojet engine performance. The test vehicle was a J60-P-6 turbojet engine which was operated at sea level hot day inlet conditions for simulated flight Mach numbers of 0.0, 0.5, and 0.85. Effects of vitiated inlet-air were evaluated at vitiation levels of 1.7, 2.3, 3.0, and 3.5 percent. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-37449 Maryland Univ., College Park.

A STUDY OF LOW ENERGY GALACTIC COSMIC RAYS FROM 1961 TO 1965

Bonnard John Teegarden (Ph.D. Thesis) 1967 120 p

Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-3390

Results from a series of balloon flights beginning in 1961 and ending in 1965 are presented. Measurements of the cosmic ray intensity were made using a dE/dx and E detector sensitive to energies from 15 to 80 MeV/nucleon. Proton and helium intensities at 85 MeV/nucleon are presented for the five year period covered by the balloon flight series. The behaviour of the proton to helium ratio as a function of time is discussed within the

framework of Parker's model for the solar modulation of cosmic rays. In 1965 a modified version of the dE/dx and E detector with an extended energy range was flown for the first time. A cosmic ray helium spectrum from 60 to 500 MeV/nucleon measured by this detector is presented. A totally empirical atmospheric secondary proton spectrum is derived, based on simultaneous balloon and satellite measurements. This spectrum is compared with the secondary spectrum obtained from a nuclear emulsion measurement and the differences are discussed. Using our empirical secondary spectrum, we obtain an upper limit for the re-entrant albedo at Sioux Falls. Dissert. Abstr.

N68-37456 New Mexico Univ., Albuquerque.
ROCKET PROBE MEASUREMENT OF ELECTRON ENERGY SPECTRA IN THE EARTH'S RADIATION BELTS
Donald Stuart Robb (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3493

A highly directional electron spectrometer using silicon semiconductor particle detectors in a multiple coincidence system was developed for the investigation of electron energy spectra in the earth's radiation belts. The spectrometer responded to electrons in the energy range from .1 to 5 Mev and discriminated against protons with energies in excess of .5 MeV. Details of instrument construction and electronic circuit diagrams are given. The instrument was used on a rocket probe whose trajectory traversed the inner belt and a portion of the outer belt in June, 1965. Details of probe instrumentation are summarized, and data obtained from the electron spectrometer are presented. Dissert. Abstr.

N68-37460 Stanford Univ., Calif.
A RADAR INVESTIGATION OF THE SOLAR CORONA
John Everett Ohlson (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-17473

During the summers of 1963, 1964 and 1965 at Stanford University, over 200 attempts were made to obtain radar reflections from the solar corona. A frequency near 25 MHz was used with a 300 kilowatt transmitter and an antenna of 25 db gain. Positive indications of echo returns were not obtained for any of the individual runs, so groups of runs were weighted and summed according to various criteria, in order to improve the detection capability. Extensive evidence is given that the radar system functioned properly during the experiments. This was demonstrated by use of the principal system components in extensive lunar work, by test runs involving the entire system, and by reduction of M.I.T. solar echo data with the same results as they obtained. For several months during 1963–65, the radar cross-section of the sun at 25 MHz was less than two units of disk area. This becomes very interesting when compared to the 1959 Stanford results at the same frequency. In 1959, six separate measurements with positive results indicated a radar cross-section of abouth 60 times the visual disk area. Since 1959 was near a maximum of the 11-year sunspot cycle and the present data centered around the minimum of 1964, ther appears to be a strong correlation between the sun's radar cross-section at 25 MHz and its general activity as indexed by the sunspot number. An analysis of the entire system was made accounting for both time and frequency spread of the returned signal, and the effect of fluctuations in the returned signal, which are due to the time-varying reflectivity of the corona and to Faraday fading in the ionosphere and corona. Dissert. Abstr.

N68-37476 California Univ., Berkeley.
OH ABSORPTION IN THE GALAXY
William Miller Goss (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-69

A survey of northern hemisphere radio sources for 18 cm OH absorption has been completed using the 85-foot Hat Creek telescope of the University of California. The observations were made with the 100 channel receiver with frequency resolutions of 10 kHz (1.8 km/s) and 2 kHz (0.36 km/s). Galactic OH absorption lines have been found in 26 galactic sources and two extragalactic sources. In many cases, it is possible to compare the OH absorption lines observed in this investigation with the HI absorption lines found by other observers. The general agreement in velocity suggests that the OH has a similar distribution to the HI. The solution of the equation of transfer appropriate to the OH absorption case is presented. The importance of the isotropic background and the galactic background is stressed. The major processes establishing the excitation of OH in HI regions are considered. Collisions with positive ions and electrons and the 18 cm isotropic radiation field (assumed to be 3°K) dominate the excitation. The calculations predict an excitation temperature of about 20°K while the observational evidence indicates that the excitation temperature is less than about 10°K. Two possible causes for this discrepancy are discussed. For the purpose of the estimation of OH projected densities, it is assumed that the excitation temperature is 3°K (the lower limit). Based on this assumption the ratios of the OH to HI projected densities are in the range 10^{-8} to 10^{-7}. Dissert. Abstr.

N68-37505 Colorado Univ., Boulder.
TRANSIENT FLARE-ASSOCIATED PHENOMENA IN THE SOLAR ATMOSPHERE
Gerald Francis Anderson (Ph.D. Thesis) 1967 243 p
Available from Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 67-15024

Recent high time resolution studies of Hα filtergrams of the solar disk have revealed the presence of short-lived phenomena in association with solar flares. A well-defined contrast fluctuation is seen to propagate away from the flare region and, upon encountering a filament, to cause the absorption profile of the filament to undergo several periodic oscillations. Using the flare patrol data of a solar observatory, the characteristics of a propagating disturbance of 20 September 1963 and its effects upon filaments are discussed. A theoretical model is developed for the disturbance. The distance is assumed to consist of a magnetohydrodynamic pulse generated by a source located in the flare region, propagated away from the source, and refracted in the solar corona. A portion of the distrubance front arrives at chromospheric levels, where the sequential times of arrival of different elements of the front are manifested as a progressive contrast fluctuation. Ray tracing calculations are undertaken to compute the progress of the disturbance front in a model atmosphere threaded by a dipolar magnetic field. The results, when fitted to the observations, yield source heights and magnetic field strengths and polarities at photospheric levels which are consistent with other observations of these quantities. Dissert. Abstr.

N68-37659 New Mexico Univ., Alburquerque.
MEASUREMENTS OF SOLAR X-RAY EMISSION FROM THE IONS CARBON VI AND NITROGEN VII
Winifred Doyle Evans (Ph.D. Thesis) 1967 178 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-3466

Two identical instrument packages containing x-ray crystal spectrometers were flown aboard Nike–Tomahawk sounding rockets. Each package contained eight curved crystal, nonscanning spectrometers focused for selected wavelengths of the solar spectrum between 19 and 34 Å. During the high altitude portion of the flight the instrument axis was aligned toward the sum by an attitude control system. Four of the spectrometers used lead stearate soap film analyzers. Three were focused for the Lyman-α, $-\beta$, and $-\gamma$ lines of C VI. The fourth was focused to obtain a measurement

of the continuum intensity at 28.0 Å. Three spectrometers using KAP crystals were focused for the first three lines of the N VII Lyman series. The eighth spectrometer had the crystal replaced by a polished aluminum surface to test the sensitivity of the instruments to scattered ultraviolet light. Dissert. Abstr.

N68-37682*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORONAE AROUND HELIUM STARS AND X-RAY SOURCES
Kyoji Nariai Sep. 1968 6 p 4 refs Presented at the 2d Colloq. on Mass Loss from Stars, Trieste, Italy, 12–16 Sep. 1968
(NASA-TM-X-63364; X-641-68-360) CFSTI: $3.00/MF $0.65 CSCL 03B

Calculations of the acoustic energy generation for helium rich composition show that the maximum acoustic energy generation is located around 12,000°K at log g = 4 and 15,000°K at log g = 6. X ray from a corona around a helium star is strongest when the physical parameters of the star are log g ≈ 6 and Te ≈ 15,000°K. But the total energy flux is too small to account for the observed X ray sources. Author

N68-37725*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
VLF EMISSIONS DURING MAGNETIC STORMS AND THEIR ASSOCIATION WITH 40 keV ELECTRONS
David P. Cauffman and Donald A Gurnett Jul. 1968 43 p 42 refs
(Grant NGR-16-001-043; Contract Nonr-1509(06))
(NASA-CR-97313; Rept.-68-55) CFSTI: $3.00/MF $0.65 CSCL 04A

Spectrograms of very low frequency radio noise recorded by satellite Injun 3 at invariant latitudes greater than 50°N were used to determine the behavior of VLF emissions during magnetic storms. Variations in the wide-band intensity of VLF emissions from L = 3 to L = 8 were studied for the period from 28 April to 28 August 1963. Spectral characteristics of the VLF emission designated polar chorus which appears at the onset of a sudden commencement magnetic storm are described. Contour maps of wide-band VLF field strength as a function of shell parameter L and universal time are presented for May through August, 1963. A correlation with D_{st} is observed. The wide-band VLF noise intensity rises from the background noise level at the onset of a magnetic storm and peaks during the early recovery phase. The Kennel–Petschek limiting flux hypothesis was studied by looking for VLF noise on the appropriate L-shells when equatorial ≥ 40 keV electron fluxes reach predicted limiting values. The VLF noise levels predicted in the equatorial plane by Kennel and Petschek were not observed at the altitude of the Injun 3 satellite (less than 2785 km). Author

N68-37753*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONVECTION ELECTRIC FIELDS AND THE DIFFUBION OF TRAPPED MAGNETOSPHERE RADIATION
Thomas J. Birmingham Sep. 1968 42 p refs
(NASA-TM-X-63374; X-641-68-356) CFSTI: $3.00/MF $0.65 CSCL 04A

We explore here the possible importance of time-dependent convection electric fields as an agent for diffusing trapped magnetospheric radiation inward toward the earth. Using a formalism based on first principles, and adopting a simple model for the magnetosphere and its electric field, we succeed in deriving a one dimensional diffusion equation to describe statistically the loss free motion of mirroring particles with arbitrary but conserved values of the first two adiabatic invariants M and J. Solution of this equation bears out the fact that reasonable electric field strengths, correlated in time for no longer than the azimuthal drift period of an average particle, move particles toward the earth at a rate at least an order of magnitude faster than electric fields whose source is a fluctuating current on the magnetopause. Author

N68-37754*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COSMIC GAMMA-RAY SPECTRUM FROM SECONDARY PARTICLE PRODUCTION IN THE METAGALAXY
F. W. Stecker Oct. 1968 26 p 22 refs
(NASA-TM-X-63369; X-641-68-391) CFSTI: $3.00/MF $0.65 CSCL 20H

The purpose of this paper is to discuss the form and intensity of the spectrum of cosmic gamma-rays resulting from the production and decay of neutral pi-mesons produced in metagalactic cosmic-ray p–p collisions. It is assumed that intergalactic space contains ionized hydrogen gas at a density of 10^{-5} cm^{-3} as is consistent with recent X-ray observations at 0.25 keV. Two models are presented to represent the possible flux of metagalactic cosmic-rays. In calculating metagalactic gamma-ray spectra, the effect of gamma-ray absorption at large red-shifts is taken into account. A discussion of the results is given. The results indicate that future gamma-ray experiments in the 1–100 MeV region may yield valuable information relating to cosmology, cosmogeny, and the metagalactic cosmic-ray flux. In particular, the metagalactic gamma-ray spectra predicted tend to peak near $70\,(1 + z_{max})^{-1}$ MeV where z_{max}, the maximum red-shift at which cosmic rays are produced, may correspond to the age of the universe at the epoch of galaxy formation. Author

N68-38007# Osservatorio Astronomico Di Roma (Italy).
SOLAR PHENOMENA
Massimo Cimino Sep. 1968 18 p *Its* Monthly Bull. no. 129
CFSTI: HC $3.00/MF $0.65

Tables and graphs are presented containing the following for September, 1968: (1) daily total areas of sunspot groups; (2) heliographic position, classification, and area of sunspot groups; (3) longitudinal sunspot magnetic fields; (4) hours of H_α cinematographic patrol; and (5) Sudden Cosmic Noise Absorption, 18 Mc/s, and Sudden Enhancement of Atmospherics, 27 Kc/s. K.W.

N68-38364# California Univ., Berkeley. Space Sciences Lab.
LARGE-SCALE CONFIGURATION OF THE CORONAL AND INTERPLANETARY MAGNETIC FIELD
Kenneth H. Schatten 15 Aug. 1968 125 p refs *Its* Ser. 9, Issue 39
(Contract Nonr-3656(28); Grant NsG-243)
(AD-674527)

A physical model that is consistent with many of the properties observed in the corona and in interplanetary space has been developed. The model allows the large-scale magnetic field configuration above the photosphere to be computed from photospheric magnetic field observations using Greens function solution to Maxwells equations. Sources for the magnetic field are related to the observed photospheric field and to the field computed at a source surface about 0.6 solar radii above the photosphere. The model is able to explain the shape of rays and streamers in the inner corona. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-37488 New Mexico Univ., Albuquerque.
A STUDY OF ELECTRONS IN THE EARTH'S MAGNETOTAIL WITH THE VELA LAUNCH 2 SATELLITES
Michael Davis Montgomery (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-3475

Detailed results of Vela satellite observations of energetic electrons ($\geq$ 45 keV) at 17 R_E (earth radii) during the period extending from July 18 to June 20, 1964, are presented. These observations were accomplished by means of a silicon solid-state detector capable of measuring electron fluxes between 45 and 300 keV. Power-law and Maxwell–Boltzmann least-squared fits have been made to the data, and the results of some 80,000 fits have been used in this analysis. Only data concerning the earth's magnetic tail are considered here. Geometrical frequency distributions, which indicate the fraction of time electrons were present during the period of measurement, are included which show, with about $\pm 5^\circ$ resolution, the size and shape of the region at 17 R_E within which energetic electrons occurred during the period of study. Dissert. Abstr.

N68-37567 State Univ. of Iowa, Iowa City.
OPTIMAL FIXED TIME ORBITAL TRANSFER WITH A RADIAL CONSTRAINT
David Robert Glandorf (Ph.D. Thesis) 1967 73 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-2822

The basic problem considered in this study is one of performing an optimal two-dimensional rocket transfer between two terminals in an inverse square law gravitational field. A radial constraint is included in the analysis to prevent the trajectory from reaching a radius less than some prescribed value. The calculus of variations is used to develop a set of necessary conditions for both impulsive and bounded thrust. An additional necessary condition which must be satisfied along optimal singular constrained subarcs is derived from a consideration of a special type of control variation. The general theory is then applied to the problem of fixed-time minimum propellant transfer with the initial mass open and a fixed final mass. Numerical results are given for several impulsive intercept and rendezvous problems. All of the solutions obtained are for either transition problems in which the trajectory is tangent to the constraint at one point or unconstrained problems. Dissert. Abstr.

N68-37571# Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk.
SIMULTANEOUS OBSERVATIONS OF H α AND THE K-LINE OF Ca-2 IN THE SOLAR SPECTRUM
Oddbjoern Engvold 1967 13 p 24 refs
(NP-17529; Rept.-24)

A simple method for simultaneous observations of the K line of Ca II and the Hα is described. It is shown that the same technique may easily be applied for other strong lines in the solar spectrum. Author (NSA)

N68-37578 California Univ., Los Angeles.
TRAJECTORY OPTIMIZATION OF A MANEUVERING BALLISTIC RE-ENTRY VEHICLE
Allen Dean Dayton (Ph.D. Thesis) 1967 158 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-3255

This dissertation considers the problem of optimizing the terminal phase of the trajectory of an Intercontinental Ballistic Missile in the presence of an interceptor missile. The re-entry vehicle is a high weight to drag ratio cone capable of maneuvering in the atmosphere. The optimization criterion is a linear combination of minimizing the terminal errors at the target due to the errors produced by components of the inertial guidance system and maximizing the minimum distance between the re-entry vehicle and an interceptor missile. It is assumed that the re-entry vehicle has full knowledge of position and velocity of the interceptor missile (i.e., a deterministic situation). The interceptor missile uses a proportional navigation guidance law based on filtered estimates of the re-entry vehicle velocity and has full knowledge of the re-entry vehicles' position. The dynamic and aerodynamic properties of the reentry vehicle along with various control methods are analyzed as a prelude to the optimization procedure. Dissert. Abstr.

N68-37581 Montana State Univ., Missoula.
THE RELATIVE DISTRIBUTION OF OBSERVABLE METEOR TRIALS IN FORWARD-SCATTER METEOR COMMUNICATIONS
Norman James Rudie (Ph.D. Thesis) 1967 166 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-2905

The theoretical distribution is a function of the following variables: (1) the gain and polarization of the transmitting and receiving antennas; (2) geographical location of the communicants; and (3) the time of day and month of operation. An ecliptic radiant distribution is synthesized from the existing information on meteor orbits. Topological maps are used to illustrate the effect of the above-mentioned variables on the relative distribution of observable trails. Whenever possible, the maps conform to an existing link between The Boeing Company, Seattle, Washington, and the Electronics Research Laboratory, Bozeman, Montana. Dissert. Abstr.

N68-37639 California Univ., Los Angeles.
AN ABSOLUTE CALIBRATION OF THE ENERGY DISTRIBUTION OF TWELVE SPECTROPHOTOMETRIC STANDARD STARS
Donald Scott Hayes (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-3262

Spectrum scans of the stars α Lyrae, κ Aquilae, 58 Aquilae, ϵ Aquarii, 29 Piscium, ξ^2 Ceti, ϵ Orionis, γ Geminorum, η Hydrae, α Leonis, θ Crateris, and θ Virginis have been compared with scans of two tungsten ribbon-filament standard lamps, and energy distributions were derived. These lamps were calibrated for energy distribution in Heidelberg in 1958 and 1966. The scans were made with a reflection-grating photoelectric spectrum scanner on the 36-inch reflector of Lick Observatory and cover the range 3200 Å to 10870 Å. The bandpasses are 45 Å from 3200 Å to 5556 Å and 30 Å from 5556 Å to 10870 Å. Energy distributions for the twelve stars are given in relative monochromatic magnitudes per unit frequency interval normalized to zero at 5556 Å. The statistical errors are about 3% from 3200 Å to 3800 Å, 1% from 4000 Å to 5000 Å, 3% from 5000 Å to 7000 Å, and 2% from 7000 Å to 10870 Å. All systematic errors are estimated to be about 5% in the ultraviolet, about 4% from 7000 Å to 10870 Å, and about 2% everywhere else. Dissert. Abstr.

N68-37642 Michigan Univ., Ann Arbor.
THE SPECTRAL CLASSIFICATION OF CARBON STARS
Rebecca Courtney Parks Gordon (Ph.D. Thesis) 1967 223 p
Available from Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 67-17764

Studied were 144 carbon stars in the red and/or blue spectral regions at dispersions usually of 88 to 106 A/mm. The stars are easily separable in the visual region into four groups: (1) the R stars, identifiable by their weak lines and bands; (2) the λ-6168 stars, distinguished by the great strength of isotopic carbon and cyanogen bands; (3) the N stars, which appear to constitute an extension to lower temperature of the Ba II stars; and (4) the D-line stars, such as WZ Cas, with weaker carbon and cyanogen bands and stronger atomic lines than the N stars. In general, the results show: (1) reliable spectral luminosity indicators are not available and perhaps not necessary (other data place these

stars at or somewhat above class III); (2) most of the carbon stars have the same carbon abundance; and (3) a one-dimensional classification system based on the stellar surface temperature is sufficient for the vast majority of the carbon stars. Dissert. Abstr.

N68-37655 Ohio State Univ., Columbus.
MODEL PLANETARY NEBULAE: ELECTRON TEMPERATURES AND IONIZATION STRATIFICATION
James Patrick Harrington (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-2996

A sequence of model planetary nebulae has been constructed in order to determine the electron temperature and ionization structure; various auxiliary quantities, such as the total emission in certain lines of H I, He I, He II, [O II], and [O III], have also been calculated. The nebulae are idealized as homogeneous spherical shells illuminated by central stars whose flux is represented by the model atmospheres of Böhm and Deinzer. The radius and density are chosen so that the models fall on the Seaton sequence. The gas is considered to be composed of H, He, C, N, O, and Ne. The cooling of the gas by collisional excitation includes the fine structure levels as well as the transitions between the terms, and full account is taken of collisional de-excitation. The thermal stability of the gas against the formation of condensation is tested at each point. Dissert. Abstr.

N68-37656 Ohio State Univ., Columbus.
A STUDY OF MULTIPLE STAR SYSTEMS INVOLVING COMPONENTS OF SPECIAL ASTROPHYSICAL INTEREST
David Dering Meisel (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-3020

Sixty-six visual double star systems were studied both spectroscopically and photometrically. The systems selected for study involve components of special astrophysical interest mainly among the OB, Be, and supergiant stars. Also some pairs including variable stars, peculiar-A stars, and high-velocity stars were considered. Using spectrograms with dispersion 40 Å/mm, Morgan-Keenan (MK) spectral types, and V sin i values were obtained for at least two stars in each system. Photographic hydrogen line (Hγ) equivalent widths were measured for a number of the early-type components. In addition, photoelectric magnitude differences (Δ m) and Balmer-line indices (Hβ and Hγ) were measured for a number of systems not previously investigated. Dissert. Abstr.

N68-37657 Cornell Univ., Ithaca, N. Y.
CARBON BURNING STARS
Gilles Beaudet (Ph.D. Thesis) 1967 157 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-3496

Models for stars of an initial composition of 50% (per mass) carbon and 50% oxygen are calculated using the Henyey method. General formulas are derived for the equations of state, the dielectric constants and the energy losses due to neutrino processes in a hot plasma; the creation of positron-electron pairs is considered an important development. Two sets of models are run, one without neutrino energy losses, which include the .75 $M_\odot$, .80 $M_\odot$ and 1.25 $M_\odot$ models, and one with neutrino energy losses, which includes the .75 $M_\odot$, .95 $M_\odot$, 1.00 $M_\odot$, 1.05 $M_\odot$ and 1.25 $M_\odot$ models. The minimum mass for carbon burning is found to be .79 $M_\odot$ in the absence of neutrinos, and approximately 1.00 $M_\odot$ if the neutrino losses are included. All models with neutrinos which burn carbon show a large carbon flash, but the same models without neutrinos do not. Dissert. Abstr.

N68-37773# Konkoly Observatory, Budapest (Hungary).
A FAINT, RED VARIABLE NEAR THE NGP
N. Sanduleak and P. Pesch 8 Oct. 1968 2 p 5 refs *Its* Inform. Bull. No. 300
CFSTI: HC $3.00/MF $0.65

A marked variability was detected in a faint, late M-type star located at the 1950 coordinates, R.A. = 13^{h}00.3^m, D. = +31°, l^{II} = 85°, and b^{II} = +86°. It was estimated that the star showed V = 13.5 on May 25, 1962 but had brightened to V = 12.3 on April 27, 1963. The star is classified as type M8, is very red, has a V-I index of about 4.0 mag, and is located about 6000 parsecs above the galactic plane. Its variability suggests that it is probably a halo giant. B.P.

N68-37774# Konkoly Observatory, Budapest (Hungary).
SPECTROGRAPHIC OBSERVATIONS OF THE VARIABLE STAR OMICRON ANDROMEDAE
Piero Galeotti and Laura E. Pasinetti 11 Oct. 1968 2 p 3 refs *Its* Inform. Bull. No. 301
CFSTI: HC $3.00/MF $0.65

The radial velocities of Omicron Andromedae were measured during the period 1961 to 1966 in which it was a normal B-type star. In the figure presented, results for the first Balmer lines are plotted against the phases according to the data of Schmidt. B.P.

N68-37820*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRAJECTORIES OF EXPLORERS 33, 34, AND 35, JULY 1966-JULY 1968
K. W. Behannon, D. H. Fairfield, and N. F. Ness Sep. 1968 29 p 14 refs
(NASA-TM-X-63370; X-616-68-372) CFSTI: HC $3.00/MF $0.65
CSCL 22C

Solar ecliptic plane projections are presented on the orbits of the Explorer 33, 34, and 35 satellites. Figures depict the Explorer 33 orbits from launch on July 1, 1966 through June 1967, and show orbit segments pertinent for near earth studies in the night side magnetosphere. The approximate positions and orientations of the Explorer 34 orbits 1 to 50 from May 24 to December 26, 1967 are also depicted; the orbit period is 4 1/3 days. Apogee and perigee times for orbits 1 to 13 are listed for use in correlating the Explorer 34 position with that of Explorer 33 during May to July 1967. Also plotted are the orbit projections of all three spacecraft for successive periods of one month, collectively covering the period from July 1967 to June 1968. M.G.J.

N68-37875*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENTIFIC QUESTIONS FOR THE EXPLORATION OF THE TERRESTRIAL PLANETS AND JUPITER. ADVANCED PLANETARY MISSIONS TECHNOLOGY PROGRAM Progress Report
R. J. Mackin, Jr., J. B. Adams, F. P. Fanale, C. B. Farmer, L. D. Gray et al 1 Oct. 1968 51 p refs
(Contract NAS7-100)
(NASA-CR-97317; JPL-TM-33-410) CFSTI: HC $3.00/MF $0.65
CSCL 22A

To provide a scientific basis for priority ordering of experiments for planetary missions in the 1970s, the approach taken is evaluation of the potential of experiments and mission for answering questions bearing on the key scientific goals of the planetary program, viz understanding the origin and evolution of the solar system, and the distribution and role of life in the solar system. Questions concerning each individual planet are listed which bear upon more general questions or upon similar questions concerning life. For orientation, the chapter on each planet begins with a resume of the current state of knowledge of that planet. This is followed by a projection of some of the advances in knowledge

expected by 1971. Finally, the list of questions is presented on the planet, each with remarks on the implications of the question and with a discussion of the types of experiments that will contribute toward answering the question. Several appendixes treat topics considered worthy of some amplification. Author

N68-37895# Library of Congress, Washington, D. C. Aerospace Technology Div.

GAMMA-RADIATION OF THE MOON AND COMPOSITION OF THE LUNAR ROCKS FROM MEASUREMENTS BY LUNA-10

Ivan Velinov *In its* Foreign Sci. Bull., Vol. 4, No. 9 Sep. 1968 p 31–38 6 refs (See N68-37893 24-23)

A description is given of the instrumentation carried on board the Luna-10 automatic station, and data are presented on the intensity of the gamma radiation emitted from the lunar surface. Author

N68-37917# Konkoly Observatory, Budapest (Hungary).

MINIMA OF ECLIPSING VARIABLES

Ioan Todoran 12 Sep. 1968 4 p 2 refs *Its* Inform. Bull. No. 299

CFSTI: HC $3.00/MF $0.65

Tabulated data are presented on 90 minima of 12 stars. The stars are in the following constellations: Andromeda, Cassiopeia, Cygnus, Delphinus, Draco, Hercules, Perseus, Taurus, and Triangulum. N.E.N.

N68-37919# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A NUMERICAL INVESTIGATION OF LOW ALTITUDE, LOW ECCENTRICITY ORBITS SUSTAINED BY IMPULSIVE THRUST, COTANGENT TRANSFER MANEUVERS

Kent M. Monroe (M.S. Thesis) Jun. 1968 120 p refs

(GA/MECH/68-3; AD-672027)

The paper presents a numerical investigation of the extension of orbital lifetimes for low altitude, nearly circular orbits through the use of cotangent transfer maneuvers performed by impulsive thrust applications. Lifetime comparisons are made with corresponding continuous thrust lifetimes computed for a circular orbit at 600 thousand feet. The results of the investigation reveal that the impulsively sustained orbit is less efficient than the continuous thrust orbit. A supporting investigation of the drag perturbed transfer orbit revealed significant changes in the impulse requirement, transfer time, and transfer distance when compared to the two-body prediction. Author (TAB)

N68-37921# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.

COSMOLOGY WITH INVARIANT COMMUNICATION TIMES

Dominic G. B. Edelen Jun. 1968 23 p 5 refs *Its* Res. Commun. No. 64

(Douglas Paper-5140; AD-674751)

If t represents the usual cosmic time parameter, with t sub o being the present epoch, a tau-time is defined by the relation d tau = R(t sub o)dt/R(t) where R(t) is the radius of the universe at time t. Assuming that the results of special relativity hold at each epoch with respect to tau-time, it is shown that any two co-moving bodies that can be connected by light signals have an invariant communication time with respect to tau-time, and the velocity of light is given by C( ) = c/(d tau(t)/dt). Even though this result necessitates certain basic changes, it is shown that the same relations hold among distance, red shift, luminosity, and the Hubble parameter as obtained in classical cosmology, and that observations at the present epoch do not differentiate between tau-time and t-time. Basically, the results show that tau-time is a natural dynamical time for cosmological investigations and its use rearranges the line element in such a way that the time-wise pathology occurs only through a conformal factor. TAB

N68-38036# Joint Publications Research Service, Washington, D. C.

ASTRONOMY

In its Soviet-Bloc Res. in Geophys. Astronomy, and Space, no. 189 1 Oct. 1968 p 1–16 ref (See N68-38035 24-13)

The red spot of Jupiter, current problems in astrophysics, temperatures of cometary nuclei, and the origin and chemistry of planets are among the new articles on astronomical developments in the Soviet sphere. Mention is made of the Sixth All-Union Conference on Radio Astronomy in Riga, partial and total solar eclipses, and telescope production. Abstracts of scientific articles in astronomy are also presented, including studies of atmospheric turbidity, radiation observations during a partial solar eclipse, and drift of a bolide trail. Other abstracts cover hyperbolic meteor orbits, behavior of noctilucent clouds during the IQSY period, and polarization of lunar radio emission at 0.8 cm. Studies are reported of meteor ablation, visual mapping of Saturn, and the effects of dispersion on spectrographic and photographic observations. M.W.R.

N68-38063# Brandeis Univ., Waltham, Mass. Dept. of Physics.

EVOLUTION OF A 30 SOLAR MASS, POPULATION 1 STAR

Alan M. Schindler Jul. 1968 176 p refs

(Contract AF 19(628)-4019)

(AFCRL-68-0364; SR-4; AD-674630)

The problem of stellar evolution can be divided into three phases: the formation of stars from the interstellar medium; the evolution of stars through various stages of expansion and contraction, increasing and decreasing brightness and temperature, and through various changes in chemical constituents, the question of the final stellar state. In this thesis the second phase of the problem is investigated for a 30 solar mass star of Population I. TAB

N68-38126# Radio and Space Research Station, Slough (England).

CATALOGUE OF ROCKET AND SATELLITE DATA IN WORLD DATA CENTRE C, 1 JANUARY–30 JUNE 1968

30 Jun. 1968 32 p

CFSTI: HC $3.00/MF $0.65

In the rocketry data tabulations presented, the country of origin, the type of rocket, and the launch date are listed. Satellite data tables give the country of origin, the satellite designation, the type of observation, and the period of observation. Results of visual and photographic observations of Soviet artificial earth satellites are also listed. M.G.J.

N68-38244# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF OPTIMIZATION IN THE MECHANICS OF SPACEFLIGHT WITH SMALL THRUSTS [PROBLEMY OPTIMIZATSII V MEKHANIKE KOSMICHESKOGO POLETA S MALOI TYAGOI]

G. L. Grodzovskii, Yu. N. Ivanov, and V. V. Tokarev 17 Nov. 1967 27 p refs Transl. into ENGLISH from Analit. Mekhan. Ustoichivost Dvizheniya, Nebesnaya Ballistika (Moscow), no. 1, 1965 p 181–197

(FTD-HT-23-1241-67; AD-674151) CFSTI: HC $3.00/MF $0.65

The authors consider the problem of optimization in the mechanics of space flight with low thrust. Included in this problem are selection of the optimum ratios between the weight components of the spacecraft and optimum control of the thrust system as well as determination of the optimum trajectories of the flight in the aggregate. A relationship is established between the weight characteristics and parameters of the engine system and the possibilities for thrust control are discussed. Optimization of flight mechanics is considered in detail for systems using solar sails

and power-limited propulsion systems, e.g. electric reaction engines. It is shown that the problem of optimization for an ideal system resolves into two independent problems: (1) finding the optimum ratio between the weight of the power source and the weight of the working material and (2) finding the optimum trajectories and programs for the rocket acceleration vector. The literature covering the numerical solution of these problems is briefly reviewed.
Author (TAB)

N68-38246*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR 7 MISSION REPORT. PART 2: SCIENCE RESULTS
15 Mar. 1968 380 p refs
(Contract NAS7-100)
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N68-38247*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PRINCIPAL SCIENCE RESULTS FROM SURVEYOR 7
L. D. Jaffe, C. O. Alley, S. A. Batterson, E. M. Christensen, S. E. Dwornik et al *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 5–7 refs (See N68-38246 24-30)

Photographic results from Surveyor VII indicated a great variety of rock fragments scattered about on the lunar landing site at the rim of the crater Tycho; and size-frequency distribution of the fragmental debris showed the average grain size to be coarser at this landing site than at other Surveyor sites. Normal luminance factor of the undisturbed fine-grained material near the spacecraft was 13.4% whereas the rock fragments scattered over the lunar surface had estimated normal luminance factors from 14 to 22%. Polarization maximum of 7 to 8% at 90 to 100 deg angles was revealed for the fine-grained material near the landing site. The soil at the Surveyor VII landing site resembles that of previous sites, and, as with previous Surveyor missions, lunar soil adhered to the spacecraft components. Chemical analysis characterized the soil as a basaltic composition with low iron content, whereas previous maria samples were found to be basaltic with a high iron content. Chemical data from Surveyors V, VI, and VII contradict a lunar origin for most meteorites.
M.W.R.

N68-38249*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR SURFACE MECHANICAL PROPERTIES
E. M. Christensen, R. E. Hutton, L. D. Jaffe, R. Choate, S. A. Batterson et al *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 77–134 refs (See N68-38246 24-30)

Influence of the crater rock population on the mechanical properties at the Surveyor VII Tycho landing site was compared with results obtained from previous Surveyor landings. Mechanical properties were derived from telemetry data and from studies of pictures depicting surface disturbances caused by the landing impact. A description of the spacecraft landing is presented, along with observations of spacecraft/soil interactions, actual photographs indicating these interactions, and computer simulations for different in lunar surfaces. Soil, rock, and terrain characteristics are detailed. The soil was found to be fine-grained and slightly cohesive, with disturbed soil particles tending to readhere; and soil ejected by the footpads was darker, had a rougher surface, and a larger effective grain size than undisturbed soil. Static bearing strength of the lunar soil increased with depth, and soil at this highland site was generally similar in mechanical properties to that at mare landing sites except for the higher rock population.
M.W.R.

N68-38251*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR SURFACE TEMPERATURES AND THERMAL CHARACTERISTICS
G. Vitkus, R. R. Garipay, W. A. Hagemeyer, J. W. Lucas, B. P. Jones et al *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 187–208 refs (See N68-38246 24-30)

Thermophysical properties of the Surveyor VII landing site were determined from earth-based observations, and measured temperatures revealed the characteristic directional effects of the infrared emission of the lunar surface. Total solar albedo was determined to be 0.17, and lunar surface brightness temperatures of the Tycho landing site region were derived assuming constant thermal properties. The spacecraft itself did not carry any instruments to measure lunar surface temperatures or thermal characteristics but the outboard-face temperatures of compartments A and B were used for these determinations. Sudden changes in temperature occurred on these outboard faces; and these fluctuations were considered caused by shadows cast on the compartment faces or on the lunar surface near the compartment by the solar panel or the planar array antenna. The procedure for calculating lunar surface temperatures is included, and differences between lunar surface and earth-based temperatures are discussed.
M.W.R.

N68-38252*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR SURFACE ELECTROMAGNETIC PROPERTIES
D. O. Muhleman, W. E. Brown, Jr., L. Davids, and J. Negus de Wys *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 209–240 refs (See N68-38246 24-30)

Radar reflectivity analysis and lunar magnetic materials studies are reported for the Surveyor VII mission, for which the terminal approach guidance system consisted of four continuous-wave radars. One beam, pointed along the roll axis of the spacecraft, obtained range measurements in this direction; the other three beams measured Doppler velocity components at a fixed angle of 25 deg from the roll axis. The four separate receivers used an automatic gain-switching procedure in steps of 20 db. Signal strength data thus obtained were reduced to radar cross sections per unit area, and cross sections were computed as a function of beam incidence angle. Tracks of the beams on the lunar surface are discussed, and radar data obtained by Surveyor VII is

compared with those from previous Surveyor spacecraft. Magnetic data were obtained with magnet assemblies attached to the footpads of the surface sampler, and some laboratory studies were made with the surface-sampler magnets. The small amount of magnetic material in the upper 5 cm of the lunar surface does not indicate an observable meteoritic nickel-iron addition. A 1.2 cm diameter object attracted to the surface sampler may be either a magnetite or a nickel-iron meteoritic fragment. M.W.R.

N68-38253*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CHEMICAL ANALYSIS OF THE MOON AT THE SURVEYOR 7 LANDING SITE: PRELIMINARY RESULTS
Ernest J. Franzgrote, James H. Patterson, and Anthony L. Turkevich *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 241–266 refs (See N68-38246 24-30)

The undisturbed lunar material obtained from the ejecta blanket of the crater Tycho by Surveyor VII contained less of the iron group of elements than lunar maria samples obtained by earlier Surveyor spacecraft. As with previous Surveyor samples, the present material does not have a chemical composition corresponding to that of condensed solar atmosphere. Except for iron content, the Surveyor VII sample compares with the chemical composition of terrestrial basalts and basaltic achondrites. When compared with terrestrial diorite, the iron content matches but the lunar sample has too little calcium. The lower iron content is considered a contributing factor to the higher albedo of the Tycho highland as compared to the lunar maria. If this lower content is characteristic of the highland regions, then it is considered probable that the bulk density of the subsurface rocks of the highland regions is less than that for comparable material of the maria. Instrument and mission descriptions for the chemical analysis of lunar material are included. M.W.R.

N68-38254*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR THEORY AND PROCESSES
D. E. Gault, J. B. Adams, R. J. Collins, G. P. Kuiper, H. Masursky et al *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 267–313 refs (See N68-38246 24-30)

The geologic setting is detailed for the Surveyor VII lunar landing site on the northern rim of the crater Tycho, and the geologic map of the Tycho region obtained by Orbiter V is included along with other Orbiter and Surveyor maps and photographs. A comparison of preliminary chemical analyses from Surveyor V, VI, and VII is tabulated, with the elemental content of representative rocks included. Contrast in albedo at highland and maria sites of the moon are discussed, density of lunar surface rocks is estimated, and the bulk composition of the moon is discussed. The thermal regime of the moon considered; as are chondritic meteorites, tektites, and solar system implications. Rock types in the Surveyor VII landing site area are discussed, with photographs illustrating various formations. Lunar surface material is discussed and observations of a post-sunset horizon afterflow are reported that are similar to those seen by Surveyors V and VI. M.W.R.

N68-38255*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POST-LANDING TRACKING DATA ANALYSIS
F. B. Winn *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 315–327 refs (See N68-38246 24-30)

Surveyor VII post-landing tracking data acquired by the Deep Space Instrumentation Facility are described, along with the use of these data in determining the selenocentric location of the probe and the geocentric locations of the Deep Space Stations used in the tracking operations. Tracking data validity and weighting are discussed, as are the a priori parameter standard deviations assigned to the measurements, the two lunar ephemerides used, and the parameter solution vector. Terrestrial tracking positions calculated from land surveys and Ranger and Mariner spacecraft are compared with the reductions of the Surveyor VII data. Other efforts related to tracking data analysis are noted. M.W.R.

N68-38257*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ASTRONOMY
P. H. Norton, J. E. Gunn, W. C. Livingston, G. A. Newkirk, and H. Zirin *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 337–340 refs (See N68-38246 24-30)

Three of the seven pictures of the solar corona obtained during the period between 8 and 14 hours after sunset are included in this brief review of Surveyor VII spacecraft astronomy. The bright, inner K-corona was photographed immediately after sunset at a time when there was unusually low activity on the solar disk, and the K-corona appeared much fainter than on previous missions. The solar corona can be seen out to 10 deg or 40 solar radii on the 30-minute integration pictures; and computer processing and addition of pictures may permit measurement of coronal radiance out to 50 solar radii, whereas ground-based eclipse observations of the outer corona are limited to about 10 solar radii because of scattering in the earth's atmosphere. M.W.R.

N68-38307*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.
MODIFICATION TO THE SHADING ROUTINE IN THE HREC ORBITAL DRAG COEFFICIENT COMPUTER PROGRAM
Final Report
J. K. Lovin, A. W. Lubkowitz, and J. Y. Chrietzberg Sep. 1968 45 p ref
(Contract NAS8-20230)
(NASA-CR-98052; LMSC/HREC-A791832; HREC-0230-1) CFSTI: HC $3.00/MF $0.65 CSCL 22C

An existing orbital drag coefficient computer program was modified in relation to determining the shading effects on aerodynamic coefficients and the geometric surfaces available for input. The shading technique consists of dividing each surface on the vehicle into incremental areas, each of which is checked to determine if the incoming flow as represented by a velocity vector intersects another surface before it reaches the incremental area being checked. If the flow reaches the incremental area without intersecting another surface, then the area is not shaded and its contribution to the aerodynamic coefficients for the surface can be calculated. To cut down on computer time, a pre-shading routine was developed and incorporated into the program to determine all surfaces which cannot shade any portion of the surface under consideration. Shading and pre-shading techniques are described, a guide for the modified program is presented, and a description of the program output is included. A sample problem with a listing of the input and portions of the output is also included. M.W.R.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-37634# Sandia Corp., Alburquerque, N. Mex.
AN APPLICATION OF A COMPUTER PROGRAM FOR THE COMPUTATION OF FORCE AND MOMENT COEFFICIENTS ON ARBITRARILY SHAPED BODIES TO THE AGENA SPACE VEHICLE
C. N. Waggoner Jul. 1968 32 p 3 refs
(SC-RR-68-446) CFSTI: HC $3.00/MF $0.65

The input data deck used to compute the force and moment coefficients of the Agena space vehicle is described. The results obtained from the program are compared with two previous independent calculations. Author (NSA)

N68-37900*# Astro Research Corp., Santa Barbara, Calif.
LARGE LOW-FREQUENCY ORBITING RADIO TELESCOPE
Hans U. Schuerch and John M. Hedgepeth Washington NASA Oct. 1968 56 p 10 refs
(Contract NAS7-426)
(NASA-CR-1201; ARC-R-282) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Studies have been performed of the feasibility of a large (1500-meter) orbiting paraboloidal antenna for use in low-frequency (< 10 MHz) radio astronomy. Such a radio telescope would be extremely useful in a variety of scientific astronomical studies. A conceptual configuration has been evolved which consists of a tenuous conductive paraboloidal network which is deployed and stiffened by centrifugal forces due to spin about the axis of symmetry. Meridional tension forces are produced in the net by means of an extremely long deployable mast which runs along the axis of symmetry and forms the backbone of the structure. The entire configuration is deployed from a package suitable for launch on such vehicles as the Titan III. Results of the various theoretical and experimental analyses which have led to this baseline concept are summarized. Author

N68-37942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL LONGITUDINAL DYNAMICS OF AN EMPTY STUB D ATLAS VEHICLE
William G. Costakis and Carl F. Lorenzo Washington Nov. 1968 56 p refs
(NASA-TM-X-1882) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A test was conducted to determine the longitudinal dynamic characteristics of the Stub D Atlas without propellants or payload. The dynamic characteristics obtained are given in terms of modal damping ratios, vehicle mode shapes, and acceleration responses to a force input over the frequency range of 1 to 120 Hz. Natural frequencies were determined by comparing the acceleration response results with the mode shape and orthogonality test results. The results showed that a one-dimensional model may not be sufficient to predict the behavior of the vehicle. Author

N68-37993# Royal Aircraft Establishment, Farnborough (England).
TECHNICAL POSSIBILITIES OF AN ACTIVE MAGNETIC ATTITUDE CONTROL SYSTEM FOR SPIN-STABILIZED SATELLITES [TECHNISCHE MOEGLICHKEITEN EINER AKTIV MAGNETISCHEN LAGEREGELUNG FUER SPINSTABILISIERTE SATELLITEN]
F. Leiss, B. Maag, K. Stopfkuchen, and O. Stuckmann Jul. 1968 29 p refs Transl. of a German rept. Presented at the 8th European Space-Flight Symp., Venice, 27-29 May 1968
(RAE-LIB-TRANS-1311)

A description is given of the technical possibilities which are available for active magnetic attitude control of spin-stabilized earth satellites. Control system versions are investigated having one, two and three magnetic coils. Power consumption and weight are evaluated in relation to the trajectory, the satellite configuration, and the required accuracy of alignment of the spin axis. Author

N68-38170*# Avco Corp., Wilmington, Mass. Government Products Group.
ISOTOPE REENTRY VEHICLE DESIGN STUDY CONCEPTUAL DESIGN. PHASE IB: TROPICAL REPORT
Lloyd I. Shure Oct. 1968 324 p refs
(Contract NAS3-10938)
(NASA-CR-72463; AVSSD-0193-68-CR) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This document summarizes the Task IB conceptual design effort on the Isotope Reentry Vehicle (IRV) study. The major objective of the study is to develop a preliminary design of a 25 KW_t Pu 238 IRV. Major design emphasis is on system safety and developability. The IRV is configured to meet minimum practical diameter and weight limits. During Task IA various IRV, heat source, and heat-source heat exchanger concept combinations were developed and evaluated. Three IRV systems have been studied in a detailed conceptual design evaluation in Phase IB. 1. A minimum diameter circular planar Heat Source (HS) Array (with nonvented capsules) 2. A minimum diameter circular planar Heat Source (HS) Array (with vented capsules) 3. A minimum diameter pin cushion HS Array (with nonvented capsules) The primary objective of Task IB has been to develop candidate designs to the level required for performance comparison and then to recommend one IRV for preliminary design. Author

N68-38248*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TELEVISION OBSERVATIONS FROM SURVEYOR 7
E. M. Shoemaker, R. M. Batson, H. E. Holt, E. C. Morris, J. J. Rennilson et al *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 9-76 refs (See N68-38246 24-30)

Typography of the lunar landing site at the rim of the crater Tycho is considered on the basis of the more than 21,000 television pictures taken by the Surveyor 7 spacecraft, and a generalized topographic map of the area within 10 m of the spacecraft is shown that was prepared by focus ranging. Geology is detailed for the Tycho landing site, which is considered one of youngest, large ray craters on the moon; and aspects of the geological setting in the area around the spacecraft and the overall region are depicted. The eight mappable geological units recognized in the spacecraft area include patterned debris, ridged-lobate flow, steep-fronted flows, lunar playa material, smooth patched material, smooth flow, patterned flow, and divergent flow. Sequence of the emplacement of these units is then considered, and some of the detailed observations made by Surveyor VII are noted. The latter includes, craters, regolith thickness, fragmental debris, and surface disturbances. M.W.R.

N68-38250*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOIL MECHANICS SURFACE SAMPLER
R. F. Scott and F. I. Roberson *In its* Surveyor 7 Mission Rept. Pt. 2: Sci. Results 15 Mar. 1968 p 135-185 refs (See N68-38246 24-30)

Mechanism, scoop, temperature sensors, and mounting substructure are discussed for the Surveyor VII soil mechanics surface sampler; and its functional and operational description is detailed, including commands, telemetry and display, and calibration. A log details the daily operations of the surface sampler and photographs indicate sampler positions and operations at various intervals. The resistance of soil to penetration increased with depth of several millimeters, the soil appeared less dense, softer, and more compressible than the underlying material. The soil at the Surveyor VII site was less brittle than at the Surveyor III site; There was less general cracking at the Surveyor VII site, and tests and trenching operations provided smaller lumps or aggregates of lunar soil. Adhesion of lunar soil to the surface sampler appeared to increase with time on the lunar surface. M.W.R.

N68-38258# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKET ADD-VB-11 LAUNCHED AT CHURCHILL RESEARCH RANGE. JANUARY 1968 (OPERATIONS REQUIREMENT NUMBER 336)
May 1968 29 p refs
(SRFB-011) CFSTI: HC $3.00/MF $0.65

The engineering aspects are discussed for preparing the payload and the launching of Black Brant rocket ADD-VB-11 during an auroral disturbance on the evening of 21 January 1968. Objectives included the determination of vertical distribution of electron density and temperature; luminosity height profile of hydrogen emission H_β (4861Å); measurements of energy density spectrum and angular distribution of protons and electrons; the

electron spectrum between 40 eV and 10 keV; ionospheric inhomogeneity and absorption; and the detection of low energy auroral X-rays. Author

N68-38431# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
THREE BLACK BRANT 2 ROCKETS LAUNCHED AT CHURCHILL RESEARCH RANGE, JANUARY 1967. AAA-II-101, AD-II-105, AAA-II-102
A. Staniforth, K. A. Steele, and D. H. O'Hara Sep. 1967 60 p refs
(ERB-762) CFSTI: HC $3.00/MF $0.65

The engineering aspects associated with the launching of three scientific sounding rockets are described. The vehicles, AAA-II-101, AAA-II-102, and AA-II-105, were launched from Churchill research range in January–February 1967. The report includes a description of the payloads, the objectives of the experiments, the launching phase, and a discussion of the processed engineering data. Vehicle AAA-II-102 was launched with recovery by parachute as the objective, but a failure occurred as a result of incomplete drogue deployment. However, the payload was recovered, including a number of very good high-altitude photographs taken from the rocket in flight. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-37424 Northwestern Univ., Evanston, Ill.
EFFECTS OF THERMAL STRESSES ON FREE VIBRATIONS OF THIN CYLINDRICAL SHELL
Chung-chun Ong (Ph.D. Thesis) 1967 167 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-3209

Approximate analytical solutions of temperature distributions, thermal stresses as well as the natural frequencies associated with radial vibrations are presented for thin, cylindrical shells subjected to various thermal loadings. The problem of temperature distribution is solved by employing the heat conduction equation for a thin rod; the thermal stresses are analyzed on the basis of a linear stress-temperature relation and the vibrational frequencies are obtained by applying Donnell type equations of motion with the aid of Galerkin's method. Numerical results computed from the frequency solutions indicate that for cylinders subjected to axisymmetric heating, the change in frequency induced by thermal hoop stress in a simply supported cylinder is very small except when the cylinder is very short and thin. Larger changes, however, can be expected for clamped cylinders and the changes are primarily due to the presence of a constant axial stress brought about by the temperature increase. Dissert. Abstr.

N68-37467 New Mexico Univ., Albuquerque.
ANALOG STUDY OF IMPACT FRACTURE OF CLOSED END CYLINDERS
James Charles Wambold (Ph.D. Thesis) 1967 257 p
Available from Univ. Microfilms: HC $11.70/Microfilm $3.25 Order No. 68-3486

The application of the analog computer to the study of problems of axisymmetric elastic wave propagation in hollow cylinders with both open and flat end caps is considered. It is an approach to the overall task of solving a class of problems of impact fracture in closed-end, hollow cylinders. The study has been done in three phases. The first phase was to perform the component research in the characteristics of analog parts and circuitry. The second was to establish an analog model of the physical subject, and the third was to subject the model to loading inputs to obtain maximum shear stress, which is taken as the fracture criterion. Dissert. Abstr.

N68-37508 Colorado Univ., Boulder.
ELASTIC-PLASTIC BEHAVIOR OF PLATES
Gerald William May (Ph.D. Thesis) 1967 168 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-2658

This investigation considers the problem of the response of transversely loaded plates in the inelastic range. The plates are assumed to consist of elastic-perfectly plastic material which yields according to the Tresca yield criterion. Small deformation bending theory is applied, and the associated flow laws of the Tresca criterion are assumed to be valid in the plastic range. The entire load-deflection behavior from the elastic limit load to attainment of the ultimate load is obtained. Both axisymmetric and rectangular plates are considered with simply supported and clamped edge conditions. Experimental verification is presented. Dissert. Abstr.

N68-37511 Northwestern Univ., Evanston, Ill.
THE TRANSIENT RESPONSE OF ELASTIC SANDWICH RINGS TO RADIAL IMPACT LOADS
Mathias John Sagartz (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3216

Equations of motion are established for an elastic sandwich ring having thin facing sheets of unequal thickness. These equations are used to study the propagation of free harmonic waves in a sandwich ring and the transient response of a sandwich ring to radial impact loads. Numerical examples are given to indicate the effects of the various relevant parameters. Experimental results obtained by the dynamic photoelastic method are presented and discussed. It is shown that the ratio of the ring's extensional stiffness to its shear stiffness has an important influence on the wave propagation characteristics. The transient response of a sandwich ring with a very stiff core is almost independent of curvature. It is noted that the net circumferential (membrane) force is not significant for the concentrated load impact problem. Dissert. Abstr.

N68-37522 Colorado Univ., Boulder.
ELASTIC STRESS FIELDS AND STRESS INTENSITY FACTORS FOR FINITE BODIES WITH SINGLE EDGE CRACKS AND NOTCHES
Alma Porter Moser (Ph.D. Thesis) 1967 271 p
Available from Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 68-2661

This dissertation is concerned with elastic stress fields and stress intensity factors for finite bodies with single edge cracks and notches. The solutions are obtained by the use of Airy stress functions given by a truncated biharmonic eigen-function series. The satisfaction of the homogeneous boundary conditions along the faces of the notch or crack is ensured by the use of a set of eigenvalues which are the solutions of a characteristic equation. It was found in this study that the stress fields could best be found by specifying boundary tractions and that the stress intensity factors could best be arrived at by specifying the boundary values of the stress function and its normal derivative. Thus, it was necessary to solve each problem twice in order to obtain both the stress field and reliable stress intensity factors. Dissert. Abstr.

N68-37554 West Virginia Univ., Morgantown.
GENERAL IMPACT FORCE DETERMINATION IN THE DYNAMIC RESPONSE OF ELASTIC MEMBERS

Hsi-fang Yuan (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-2700

The force time history occurring in the longitudinal impact of a rod and the transverse impact of beams was studied by solving the Volterra type integral equations that correlate the strain history with the force time function, according to the conventional one dimensional vibrational theory of rods and beams. No assumption concerning the physical properties and geometry of the striker was made except that it is axisymmetric, that only local plastic deformation develops during the impact process, and that damping is negligible. A new trigonometric quadrature formula based on the generalized trapezoidal rule is given to replace the conventional step-by-step small increment method. The incorporation of a large number of harmonics in the calculation of stress history improves agreement with experimental results. Dissert. Abstr.

N68-37585 Northwestern Univ., Evanston, Ill.
PROPAGATION OF WAVES OF FINITE STRAIN IN ELASTIC AND VISCOELASTIC SOLIDS
Damodar Pati Reddy (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3212

The propagation of one dimensional waves of finite strain in a semi-infinite elastic rod and in elastic and viscoelastic half spaces is studied. The material of the rod and the half space is incompressible. In each of the problems studied the transient wave motion is generated by a time dependent disturbance at the free boundary of the semi-infinite medium. The semi-infinite rod is subjected to a monotonically increasing longitudinal disturbance at its free end. An implicit solution for the wave motion in the region of simple waves is obtained by the method of characteristics. Conditions for shock formation are established. By employing the theory of propagating surfaces of discontinuity, an alternate and explicit solution in this region is obtained as a Taylor expansion about the time of arrival of the wave front. Dissert. Abstr.

N68-37599 Virginia Univ., Charlottesville.
THE RESPONSE OF A THIN-WALLED, SHORT, CLOSED CYLINDER TO AN ARBITRARY MOVING PRESSURE WAVE OF SHORT TIME DURATION
Ronald Owen Hultgren (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-3150

This is an analysis of the dynamic deformation and stress characteristics of a thin-walled, short cylinder acted on by a moving pressure wave of short duration. It includes the effects of large radial deflections, plasticity of the cross section, kinematic strain hardening, and longitudinal and circumferential stiffeners in the cylinder. The cylinder wall is idealized by three distinct layers, and a bilinear stress strain curve is assumed for the wall material. The Tresca yield condition and its accompanying constitutive equations are used. Fourteen first-order nonlinear partial differential equations are developed to determine the displacements, rotations, and the forces at a finite number of points of the cylinder wall. The equations are reduced to finite difference form; the solution method is indicated in matrix notation. In this analysis the orientation of the cylinder to the pressure wave is arbitrary. Dissert. Abstr.

N68-37600 Ohio State Univ., Columbus.
BURMESTER THEORY IN THREE DIMENSIONS AND APPLICATION TO FINITE DISPLACEMENTS WITH FOUR DEGREES OF FREEDOM
Wendell Marion Williams, Jr. (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-3088

An extension of planar Burmester theory to three dimensions is investigated. Points in a moving body are of interest in kinematics if they successively fall on some line, plane, sphere, circle, cylinder, or helix, as the body undergoes finite spatial displacements. Definition is made of the maximum number of completely arbitrary positions which it should be possible to specify for each of the cases. A four-degree-of-freedom helicopter-type motion is then studied for the moving body, and the maximum number of positions which can be specified is again defined. For this motion, the line, plane, sphere, and circle problems are solved for the maximum number of positions, and the cylinder is solved for certain restricted orientations involving a reduced, but useful, number of positions. Digital computer programs and numerical examples are presented for the sphere, circle, inverse circle, and vertical cylinder problems. These are combined to solve an example synthesis problem in which a given helicopter motion is synthesized by having the moving body be the coupler in a five-link spatial mechanism. Dissert. Abstr.

N68-37623 Colorado Univ., Boulder.
THE APPLICATION OF CHARACTERISTIC FUNCTIONS TO SOME PLANE PROBLEMS IN THERMOELASTICITY
John Walter Weber (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-15054

This thesis presents the application of characteristic functions to the solution of thermal stresses in a sector of a plane circle. The heat generated is independent of time and a function of the radial coordinate only. Two temperature distributions are investigated. Stresses for sectors of 20°, 40°, 60°, 80°, 90°, 120°, 150°, and 180° are also investigated. Maximum stresses and their locations are presented. Dissert. Abstr.

N68-37652*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
HYPERVELOCITY IMPACT DAMAGE IN ALUMINUM TARGETS Final Report, 14 Aug. 1967–13 Feb. 1968
R. N. Teng Feb. 1968 63 p 1 ref
(Contract NAS9-7452)
(NASA-CR-92345; DAC-59816) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An experimental test program was conducted to determine the ballistic limits of aluminum targets under simulated meteoroid environments and to investigate the effectiveness of meteoroid shields as a function of the meteoroid's geometry, density, energy, and momentum. Forty data points of ballistic limits and hypervelocity impact on semi-infinite alumimum targets were obtained from a total of over 150 attempts. The problems encountered in launching syntactic-foam projectiles during the experiment and the techniques developed to overcome these difficulties are discussed. Author

N68-37683 Washington Univ., Seattle.
THE TRANSIENT PROBLEM IN CLASSICAL ELASTODYNAMICS SOLVED BY INTEGRAL EQUATIONS
Thomas Allen Cruse (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-3844

A general solution method for wave propagation problems in linearly-elastic, isotropic, homogeneous bodies of arbitrary shape and connectivity has been formulated. The results are given for very general states of boundary and initial data and body force terms. There is no requirement to obtain a mapping function or a Green's function for the particular body. The hyperbolic partial differential equations of motion together with the prescribed initial data are transformed to an elliptic set of equations by a Laplace transformation. Particular solutions to the transformed equation of motion corresponding to concentrated dynamic point forces in the

infinite media are obtained through the use of retarded and transformed potentials. These solutions are obtained for both the two and three dimensional problems. Dissert. Abstr.

N68-37677 Connecticut Univ., Storrs.
THE ACOUSTIC FIELD IN A CLOSED SPACE BEHIND A RECTANGULAR SIMPLY SUPPORTED PLATE EXCITED BY BOUNDARY LAYER TURBULENCE
Wayne Alan Strawderman (Ph.D. Thesis) 1967 157 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-1411

An analytic solution is obtained for the acoustic pressure statistics in a closed rectangular shaped cavity behind a simply supported, rectangular plate excited by boundary layer turbulence. The contribution of the cavity acoustic pressure is neglected as contributing to the plate excitation, leaving only the turbulent pressure fluctuations as the exciting force. The mathematical model for the turbulent pressure statistics is based on that of Corcos, which agrees well with experiments. A byproduct of this analysis is an analytic solution for the turbulent flow excited plate vibration velocity statistics. The plate velocity and cavity acoustic pressure statistics are expressed in the form of cross power spectral densities and power spectral densities. Dimensionless forms of the plate velocity spectral density and cavity acoustic pressure spectral density are developed. The dimensionless plate velocity spectral density and dimensionless cavity acoustic pressure spectral density were computed by means of a digital computer. Dissert. Abstr.

N68-37678 Northwestern Univ., Evanston, Ill.
EFFECTIVE STIFFNESS THEORY FOR LAMINATED MEDIA
Chin-teh Sun (Ph.D. Thesis) 1967 116 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-3226

An approximate theory to describe certain aspects of the dynamic behavior of periodically stratified continua is presented. The main feature of this theory is that "effective stiffnesses," rather than the conventional "effective moduli," are employed. For both the reinforcing layers and the matrix layers the displacements are expressed as linear and quadratic expansions about the mid-planes of the layers, for a first order and a second order approximate theory, respectively. The expansions are used to compute the kinetic and strain energies stored in elements of the layers, thus leading to the introduction of effective stiffnesses for both the reinforcing layers and the matrix layers. Dynamic interaction between matrix and reinforcing layers is included by securing continuity of displacements at the interfaces. With the aid of a smoothing operation, approximate kinetic and strain energy densities for the laminated medium are obtained. Subsequent application of Hamilton's principle yields the displacement equations of motion. Dissert. Abstr.

N68-37696 Northwestern Univ., Evanston, Ill.
THE INFLUENCE OF THERMODYNAMICAL EFFECTS ON STRESS WAVES IN VISCOELASTIC SOLIDS
Stephen Martin Vogel (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3233

Four problems concerned with the influence of thermomechanical coupling, thermal conductivity, and temperature-dependent material properties on the propagation of stress waves in viscoelastic media are studied. A number of features and objectives are common to the four problems. Throughout this work, the theory of propagating surfaces of discontinuity is used to investigate the behavior of the stress waves. The constitutive laws for the stress and entropy are derived from the specific free energy which is taken in the form of a functional expansion. If the medium conducts heat, it is assumed to obey Fourier's law. With the aid of the constitutive laws, relations are developed between the kinematical, mechanical, and thermodynamic quantities at the wave front. Explicit expressions are established for the velocity of the wave in every problem and, whenever possible, it is shown explicitly how the magnitude of the stress discontinuity changes as it propagates through the body. Dissert. Abstr.

N68-37836 Northwestern Univ., Evanston, Ill.
DIFFRACTION OF ELASTIC WAVES BY SEMI-INFINITE PLANE BARRIERS AT THE INTERFACE OF ELASTIC MEDIA
Lambert Ben Freund (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-3181

Three problems in elastic wave propagation concerned with the diffraction of plane dilatational waves by half planes are studied. The normal of the incident plane wave is perpendicular to the edge of the diffracting half plane, and the elastic media are in a state of plane strain. In the first two problems transient diffraction of a plane dilatational pulse of arbitrary shape by a semi-infinite, smooth rigid barrier at a fluid-solid interface and by a semi-infinite closed crack at a solid-solid interface is investigated. In the third problem, the diffraction of a plane, time harmonic dilatational wave by a thin, semi-infinite elastic plate in smooth contact with an elastic half space is treated. The two transient problems involve dynamic coupling of the semi-infinite media on both sides of an ideal diffracting barrier, while the third problem involves dynamic coupling of the diffracting barrier and the supporting solid. Real integral expressions are obtained for the displacement potentials of the two transient problems. In the third problem, analytical expressions for the plate deflection due to the incidence of a plane harmonic dilatational wave on the surface of the elastic solid are obtained. Dissert. Abstr.

N68-37840*# Lehigh Univ., Bethlehem, Pa.
FATIGUE CRACK PROPAGATION IN CYLINDRICAL SHELLS
W. M. Catanach, Jr. and F. Erodogan Washington NASA Oct. 1968 112 p 24 refs
(Grant NGR-39-007-011)
(NASA-CR-1197) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This report presents some of the results of the experimental and theoretical studies on the fatigue crack propagation in cylindrical shells subjected to fluctuating internal pressure. Most of the fatigue tests are performed on 6063-T6 aluminum alloys. In the analysis of the experimental results, the stress intensity factor is used as the correlation parameter. A modified crack propagation model is developed to take into account the effect of bending stresses, which are superimposed on membrane loads around the crack in shells. To evaluate the stress intensity factor, the integral equations obtained by Folias are solved numerically after separating the singularities. Partly to verify the theoretical results, strain measurements were made around the crack tip on the outside of the aluminum and inside and outside of the plexiglas cylinders. The results indicate that over the range of crack propagation data covering 10^{-7} to 10^{-3} in/cycle, the model adopted in this study seems to be highly satisfactory. Author

N68-37908# Atomics International, Canoga Park, Calif.
THERMAL GRADIENT EFFECTS ON STRESS-RUPTURE BEHAVIOR OF THIN-WALLED TUBING
Jon H. Shively 25 Jun. 1968 45 p refs
(Contract AT(04-3)-701)
(AI-AEC-12695) CFSTI: HC $3.00/MF $0.65

The results of stress rupture tests of internally heated and pressurized thin walled tubes of Type 304 stainless steel are presented. The tubes were immersed in high purity sodium at 1200°F and at a flow rate of 20 ft/sec. A heat flux of 10^6 Btu/ft^2-hr passed through the wall. The heat flux was applied in three modes: steady; 6-min on, 6-min off; and 1-min on, 1-min off. The purpose of these tests is to examine the separate and combined effects on creep behavior of stainless steel fuel rod

cladding from: internal NaK pressurization; thermal gradient through the cladding wall; thermal cycling; rate of thermal cycling, and mass transfer. Control tests without internal heating showed that NaK versus helium pressurization and flowing sodium have no effect on the creep behavior. Steady internal heating also has little apparent influence on creep behavior even though evidence of mass transfer was found on the surface. Author (NSA)

N68-37911# California Univ., San Diego. Dept. of the Aerospace and Mechanical Engineering Sciences.
ELASTIC-PLASTIC, WORKHARDENING ARCHES
Jenn-Ming Chern and S. Nemat-Nasser Jul. 1968 38 p 3 refs
(Contract N00014-67-A-0109)
(TR-20; AD-672032)

A set of integral equations is obtained for the stress-rates that correspond to a given rate of loading from a given elasto-plastic state in an elastic-plastic, workhardening sandwich arch. Methods of solving these integral equations are considered. It is found that the integral-equation approach permits solutions which are as accurate as desired even when the loading program involves extensive partial unloadings. Author (TAB)

N68-37937# Picatinny Arsenal, Dover, N. J. Feldman Research Labs.
EFFECT OF LOADING RATE AND WINDING SEQUENCE ON FATIGUE AND RUPTURE OF PRESSURIZED, FILAMENT-WOUND, GLASS-REINFORCED PLASTIC CYLINDERS
Merrill Eig, David W. Davis, and David Kendall (Watervliet Arsenal) Aug. 1968 65 p refs
(PA-TR-3693; AD-674649) CFSTI: HC $3.00/MF $0.65

Cylindrical glass-reinforced plastic test specimens simulating gun-tube sections were fabricated, using 4 combinations of 5 layers of helical and 7 layers of circumferential winding. These specimens were subjected to mechanical loadings similar to those occurring in gun tubes. Experimental data was used to generate curves depicting the response of burst strength to the rates of loading, cyclic loading, and various diameter-to-thickness ratios. Other mechanical properties such as Poissons ratio and elastic modulus were determined. Author (TAB)

N68-37955# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF PLASTIC DEFORMATIONS UNDER COMPLEX LOADS [EKSPERIMENTALNOE ISSLEDOVANIE PLASTICHESKIKH DEFORMATSII PRI SLOZHNOM NAGRUZHENII]
G. A. Doshchinskii et al Dec. 1967 14 p refs Transl. from Mekhan. Tverdogo Tela (USSR), no. 5, 1966 p 118–122
(FTD-MT-24-187; AD-674699) CFSTI: HC $3.00/MF $0.65

The article presents the results of a study of plastic deformation during complex loading of tubular samples of steel 45, brass, copper, and duralumin D16. A ZMDU-30 device for complex loading was used. TAB

N68-37964*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Special Projects Section.
A FINITE ELEMENT METHOD FOR THE PLASTIC BENDING ANALYSIS OF STRUCTURES
H. Armen, Jr., A. Pifko, and H. S. Levine Oct. 1968 78 p refs Presented at the AF 2d Conf. on Matrix Methods in Structural Mech., Wright-Patterson AFB, Ohio, 15–17 Oct. 1968
(Contract NAS1-7315)
(NASA-CR-97373; RE-347-J) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A finite element technique is presented for the plastic analysis of structures subjected to out-of-plane bending, alone or in combination with in-plane membrane stresses. The method makes use of a linear matrix equation of finite element analysis, formulated to include the effect of initial strains. This equation is applied to the plasticity problem by interpreting plastic strains as initial strains, the material nonlinearity being introduced through subsidiary stress-strain relations from an incremental plasticity theory. In addition, the analysis is combined with an incremental technique developed to account for the effects of geometric nonlinear behavior. Thus, the present analysis is capable of treating the combined effects of material and geometric nonlinearity. Application of the procedure is made to beam and arch structures in the presence of both types of nonlinearity, and to rectangular plates for which material nonlinearity alone is present. Author

N68-37995# National Aerospace Lab., Amsterdam (Netherlands).
THE PROPAGATION OF ELASTIC WAVES IN CIRCULAR CYCLINDRICAL SHELLS OF SANDWICH-TYPE
J. van der Vooren Jul. 1967 37 p refs Submitted for publication
(NLR-TR-W.31) CFSTI: HC $3.00/MF $0.65

The differential equations are derived, accounting for the effects of shear and rotatory inertia. Numerical solutions are given for a shell which is representative for an actual aircraft. For low, respectively high frequencies, the theory is analytically evaluated as far as possible in order to obtain simplified expressions for the calculation of propagation speeds. Their validity is checked numerically. Author

N68-38067# California Univ., Berkeley. Structural Engineering Lab.
PLANE WAVES IN LINEAR, HEREDITARY MATERIALS Interim Technical Report
Jerome L. Sackman and Izak Kaya May 1968 22 p refs
(Contract DA-31-124-ARO(D)-460)
(AROD-4547.39-E; Rept.-68-5; AD-674258)

A general procedure is developed for predicting the way in which transient pulses propagate through an arbitrary, linearly viscoelastic medium characterized by creep or stress relaxation functions. By use of the Laplace transform, differential operations in transform space, and some asymptotic methods, the boundary-value problem in question is reformulated in terms of a Volterra integral equation, with the space variable playing the role of a parameter. This equation is readily resolved numerically, and results obtained by this procedure compare very well with solutions available in the literature. Author (TAB)

N68-38076# Air Force Inst. of Tech., Wright-Patterson AFB Ohio. School of Engineering.
MOMENTUM DISTRIBUTION IN THE DEBRIS CLOUD PRODUCED BY HYPERVELOCITY PERFORATION OF THIN PLATES
John H. Cunningham (M.S. Thesis) AF Mater. Lab. Jul. 1968 99 p refs
(GSF/MC/68-4; AFML-TR-68-174; AD-674592)

An experimental investigation of the momentum distribution within the debris cloud produced by the impact of 3.17 mm spheres on 0.79 mm thick plates was conducted. Two independent experiments with projectile velocities ranging from 6.65 km/sec to 7.25 km/sec were completed in an attempt to determine momentum distribution. Small metal plates were impacted by the cloud for measurement of the incident momentum. A ballistic pendulum was used in an attempt to capture small segments of the debris cloud and to measure the momentum distribution in the cloud itself. The momentum intensity, as a function of distance from the center of the debris cloud, was determined in each experiment and the results were compared and evaluated. Author (TAB)

N68-38108# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
OBSERVATIONS ON LINEAR ANISOTROPIC VISCOELASTICITY
J. C. Halpin and N. J. Pagano Jul. 1968 29 p refs
(AFML-TR-67-424; AD-674768) CFSTI: HC $3.00/MF $0.65

The central issue in anisotropic viscoelasticity is the specification of the symmetry conditions for the time dependent stiffness or compliance matrices. This report constitutes the first experimental verification of the Onsager reciprocity relations for anisotropic viscoelastic solids and thereby establishes the basis for the stress-analysis and characterization of nonisotropic time dependent systems. An experimental method for inducing a uniform state of stress in anisotropic specimens is also presented. Author (TAB)

N68-38109# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
CREEP BUCKLING OF PLATES Final Report, 15 Jun. 1966–15 Jun. 1968
Ilan M. Levi and Nicholas J. Hoff Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Aug. 1968 172 p refs
(Contract AF 33(615)-5115)
(SUDAAR-355; AFFRL-TR-68-118; AD-674770) CFSTI: HC $3.00/MF $0.65

The effect of creep on the load carrying ability of plates was investigated. The plates were loaded by compressive forces applied in the plane of the plate. It was assumed that the material deforms due to linear elasticity and steady state creep, and creep strain rate is given by the power law. When a fixed uniaxial load is applied to the plate in such a way that the load remains uniformly distributed during the buckling process, the governing equations indicate that a finite time exists after which the lateral deformations of the plate become unbounded. Simple, closed form expressions for this critical time are derived for various values of the creep exponent, and for the case where primary creep plays an important role. Author (TAB)

N68-38116# Israel Inst. of Tech., Haifa. Aeronautical Engineering Dept.
BUCKLING OF CYLINDRICAL PANELS UNDER LATERAL PRESSURE
Josef Singer, Amnon Meer, and Menahem Baruch Mar. 1968 34 p refs
(Contract AF 61(052)-905)
(TAE-85; SR-6; AD-674064) CFSTI: HC $3.00/MF $0.65

The stability of simply-supported cylindrical panels under lateral pressure is investigated by linear theory. First, panels with classical simple supports are analyzed with the usual Donnell 8th order equation. Numerical results are presented which confirm that panels may buckle at lower pressures than corresponding complete cylindrical shells. Then the effect of circumferential restraint along the straight edges is studied by analysis of a panel with SS4 (u = v = o) boundary conditions and comparison with classical SS3 (u = N sub phi = O) supports. The coupled Donnell equations are reduced to a set of algebraic equations and the eigenvalues are solved by an iterative technique. Circumferential restraint along the straight edges results in considerable stiffening under lateral pressure. Author (TAB)

N68-38149# Israel Inst. of Tech., Haifa. Aeronautical Engineering Dept.
CONTRIBUTION TO THE THEORY OF THIN ELASTIC TOROIDAL SHELLS. PART 1: GENERAL THEORY
A. Kornecki Jul. 1968 111 p refs
(TAE-88) CFSTI: HC $3.00/MF $0.65

The peculiar behavior of a toroidal shell is discussed and the known asymptotic solutions for the axisymmetric and antisymmetric (wind-type-load) cases are briefly reviewed. The problem of a toroidal shell subject to nonsymmetric but slowly varying external loads corresponding to higher harmonics is reduced to the solution of an ordinary fourth order linear equation, in a complex stress function, with a large parameter and a turning point at $\theta = 0$. For regions sufficiently removed from the top (and bottom) circle $\theta = 0$, this equation is approximately satisfied by two exponentially behaving edge effect solutions and two slowly varying membrane solutions. However in the vicinity of the singular line the membrane and bending effects are inseparable. By suitable transformations, uniformly valid solutions are obtained which satisfy the complete equation in regions adjacent to the line $\theta = 0$, and reduce to the membrane and edge effect integrals far from this line. Author

N68-38163# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NATURAL VIBRATIONS OF SHELLS IN A FLUID
V. S. Gontkevich 11 Jan. 1968 85 p refs Transl. into ENGLISH of the book "Sobstvennye Kolebaniya Obolocher v Zhidkosti" Kiev, 1964 p 1–103 refs
(FTD-HT-23-1003-67; AD-674329) CFSTI: HC $3.00/MF $0.65

The booklet examines the natural vibrations of shells in a liquid. It cites the theory of phenomenon and presents methods of calculating the frequencies of the vibrations of shells of various shape in finite and infinite compressible and incompressible liquids at various boundary conditions. To facilitate the calculations, the booklet includes tables and graphs. Theoretical results were checked experimentally in several models of reservoirs and pipes of various shapes whose study is of practical interest. The booklet is intended for researchers, engineers, and technicians working in the area of hydroelasticity. Author (TAB)

N68-38169# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF THE EFFECT OF AN ARBITRARY DYNAMIC LOAD ON CIRCULAR AND ANNULAR PLATES [RASCHET KRUGLYKH I KOLTSEVYKH PLASTINOK NA DEISTIVE PROIZVOLNOI DINAMICHESKOI NAGRUZKI]
E. M. Gershunov 5 Jan. 1968 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. (USSR), no. 6, 1964 p 89–95
(FTD-HT-23-794-67; AD-674709) CFSTI: HC $3.00/MF $0.65

Using Hankel integral transformations the author solves the equations for axisymmetric vibration of annular plates under axisymmetric loading for several boundary and shape conditions. After integrating by parts, an expression is obtained. The solutions are obtained for the case of a circular flat plate hinged around the perimeter, for an unsupported plate, for a plate clamped around the perimeter, and for an annular plate, by choosing the correct quantity to satisfy the boundary conditions and by finding a characteristic equation. The results are extended to a round plate on an elastic foundation and radially loaded with a pressure p0 which may represent a plate either radially compressed or stressed due to thermal or residual stresses. As an example, the case of a hinged ring, loaded for a short time over its plane area, is solved. Author (TAB)

N68-38196# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
INFLUENCE OF END CONSTRAINT IN THE TESTING OF ANISOTROPIC BODIES
N. J. Pagano and J. C. Halpin Jun. 1968 31 p refs
(AFML-TR-67-425; AD-674769) CFSTI: HC $3.00/MF $0.65

One of the most elementary concepts in elasticity theory is that of a uniform state of stress. Producing such a state of stress in the laboratory, however, is not a trivial task. A common experiment in composite mechanics -- the tension test of off-angle composites -- is discussed in this report and the influence of end constraint on the uniform stress field is investigated. Analytical and experimental evidence is presented to show the serious effects caused by conventional clamping devices. Author (TAB)

N68-38233# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
LOW BUCKLING LOADS OF AXIALLY COMPRESSED CONICAL SHELLS
Menahem Baruch, Ovadia Harari, and Josef Singer Jan. 1968 60 p refs
(Contract AF 61(052)-905)
(TAE-76; SR-5; AD-674073) CFSTI: HC $3.00/MF $0.65

The stability of simply supported conical shells under axial compression is investigated for 4 different sets of in-plane boundary conditions with a linear Donnell type theory. The first two stability equations are solved by the assumed displacement, while the third is solved by a Galerkin procedure. The boundary conditions are satisfied with 4 unknown coefficients in the expressions for u and v. Both circumferential and axial restraints are found to be of primary importance. Buckling loads about half the classical ones are obtained for all but the stiffest simple supports SS4 (v = u = o). The low buckling loads for classical simple supports SS3 are confirmed by two different methods of analysis, a closed form solution in Hankel functions and a finite difference solution. Except for short shells, the effects do not depend on the length of the shell. Buckling under combined axial compression and external or internal pressure is studied and interaction curves were calculated for the 4 sets of in-plane boundary conditions. Author (TAB)

N68-38234# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BENDING CALCULATIONS FOR STRUCTURALLY ORTHOTROPIC PLATES [K RASCHETU KONSTRUKTIUNO ORTOTROPNYKH PLASTINOK NA IZGIB]
S. A. Klimov 1 Dec. 1967 48 p refs Transl. from Materialy Po Metallicheskim Konstruk. (USSR), no. 8, 1964 p 116–153
(Contract F33657-67-C-1452)
(FTD-HT-23-624-67; AD-673919) CFSTI: HC $3.00/MF $0.65

On the basis of the multilayer orthotropic shell theory, equations were obtained on the bending of thin plates consisting of an arbitrary number of orthotropic layers. The principles are given for the division of orthotropic plates into layers and for determining the resilient and geometrical characteristics of individual layers and of the plate as a whole. There is a linear solution for this problem. TAB

N68-38263# Catholic Univ. of America, Washington, D. C. Stress Analysis Labs.
EXPERIMENTAL STRESS ANALYSIS ACTIVITIES IN SELECTED EUROPEAN LABORATORIES
A. J. Durelli Aug. 1968 133 p refs
(Contracts NONR-2249(06); DA-ARO(D)-31-124-G772)
(Rept.-15; AD-674424) CFSTI: HC $3.00/MF $0.65

The report has been written following a trip conducted by the author through several European countries. A list is given, for each of those countries, of many of the laboratories doing important experimental stress analysis work and of the people interested in this kind of work. The main features of these laboratories are pointed out and references to some of the recently published material are given. An attempt has also been made to abstract the main characteristics of the experimental stress analysis methods used in some of the countries visited. The report is the result of the authors experiences and cannot be considered as exhaustive, but it is believed it will be found useful by people interested in experimental stress analysis research, and by people planning visits to foreign laboratories. Author (TAB)

N68-38264# Stanford Univ., Calif. Div. of Engineering Mechanics.
THE ELASTIC-PLASTIC BOUNDARY IN ONE DIMENSIONAL WAVE PROPAGATION
R. J. Clifton and Thomas T. C. Ting Feb. 1968 10 p refs
(Contract DA-04-200-AMC-659(X))
(TR-181; BRL-CR-9; AD-674755) CFSTI: HC $3.00/MF $0.65

The problem of moving boundaries separating elastic regions from plastic regions in one dimensional plastic wave propagation was considered by several investigators. These boundaries are called unloading waves if the material at a section changes from a plastic state to an elastic state as the wave passes the section. If the material changes from an elastic state to a plastic state, the moving boundary is called a loading wave. It was shown by other authors that the speed of an unloading wave or a loading wave must satisfy certain conditions if the time derivatives of the stress sigma sub t, on both sides of the elastic-plastic boundary are not zero. The purpose of the note is to clarify the situation in which sigma sub t and its higher derivatives are zero on both sides of the elastic-plastic boundary. Author (TAB)

N68-38296# California Univ., Berkeley. Aerospace and Mechanical Engineering Sciences Dept.
THE LATERAL BUCKLING OF A STRAIGHT OR CURVED BEAM SUBJECTED TO PURE BENDING
F. E. Vanslager Jul. 1968 42 p refs
(Contract N00014-67-A-0109-0003)
(TR-21; AD-673974) CFSTI: HC $3.00/MF $0.65

This paper presents a new analysis of the classical problem of the lateral buckling under pure bending of a curved beam with circular axis. Although a solution to this problem, and to the corresponding straight beam problem is well-accepted in the literature, the present analysis gives buckling moments which are significantly different than the usually accepted results. The difference arises from an application of new boundary conditions that are shown to be the only boundary conditions consistent with the equilibrium of the buckled beam under a pure bending moment. This new analysis provides generally higher bending moments. A short experimental program was performed, and the results tend to confirm the new analysis. Author (TAB)

N68-38310# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF ELASTOPLASTIC DEFORMATION OF SHELLS WITH OPENINGS AND REINFORCEMENTS BY THE METHOD OF PHOTOELASTIC COVERINGS
A. Ya. Aleksandrov et al 12 Sep. 1967 12 p refs Transl. from Prikl. Mekhan. (USSR), v. 2, no. 3, 1966 p 1–9
(FTD-HT-67-421; AD-674157)

Experiments were performed to study the stressed state of cylindrical shells with reinforced and nonreinforced circular, square, and rectangular openings in tension and in torsion. The experimental method used is the one of photoelastic coverings, in which the surface of the shell is covered with a thin covering of an optically active material. Shell deformations under loading are transmitted to the photoelastic covering and are manifested in the covering as the dual wave radiation, which is measured with the aid of a polarization device for reflected light. An equation is given which expresses the relationship of the optical difference of shift with the difference of principal deformations in the covering in the absence of reversals of direction of the principal deformations along the thickness of the covering. Other working equations are developed, the accuracy of this testing method is discussed, and the results are compared with analytical solutions. The limits of applicability of the analytical solutions are established. It is shown that the method developed satisfies the accuracy requirements of the study while also avoiding the series of difficulties and limitations of other known means of polarization-optical studies of shells. TAB

N68-38314# Stanford Univ., Calif. Div. of Engineering Mechanics.
INTERACTION OF SHOCK WAVES DUE TO COMBINED TWO SHEAR LOADING
Thomas T. C. Ting (Illinois Univ., Chicago) May 1968 40 p refs
(Contract DA-04-200-AMC-659(X))
(TR-180; BRL-CR-8; AD-674754) CFSTI: HC $3.00/MF $0.65

The propagation of plane elastic-plastic waves due to combined two shear loadings is studied in which the materials are assumed to be elastic, isotropic work hardening. For a general strain hardening law, analytical solutions can be obtained only for simple waves and for two shear waves which are reducible to a single shear wave. If the material is elastic, linearly strain hardening, analytical solutions can also be obtained for two shear waves due to a series of step loadings and unloadings. The solution consists of shock waves propagating at constant speeds with a constant stress state between the shocks. The interaction of two or more shocks meeting at a point, and the reflection of a shock wave from a rigid surface or from an interface between two different media are studied in detail. The results can be applied to two shear waves in a plate of finite thickness which consists of two or more layers of different materials. It is shown briefly that similar results are obtained for materials with elastic, kinematical work hardening behavior. Author (TAB)

N68-38338# RAND Corp., Santa Monica, Calif.
DYNAMIC PROGRAMMING, INVARIANT IMBEDDING, AND THIN BEAM THEORY
D. W. Alspaugh, H. H. Kagiwada, and R. E. Kalaba Aug. 1968 24 p refs
(Contract F44620-67-C-0045)
(RM-5706-PR; AD-674586)

Dynamic programming and invariant imbedding concepts are used to transform the two-point boundary-value problem of the theory of thin beams into initial-value problems that can be solved effectively by analog or digital computers. To demonstrate the computational feasibility of the methods, an example of a uniform beam of unit length, free at the left end and cantilevered at the right, was chosen, and the deflection was computed by three methods: A reference solution was computed by a segmented technique, and the deflections were then computed by dynamic programming and by invariant imbedding. Results indicate excellent agreement among the various solutions. Author (TAB)

N68-38442# Mound Lab., Miamisburg, Ohio.
PARTICLE SIZING OF PLUTONIUM DIOXIDE MICROSPHERES AFTER IMPACT
P. H. Bonnell 21 Jun. 1968 36 p
(Contract AT(33-1)-GEN-53)
(MLM-1499) CFSTI: HC $3.00/MF $0.65

Three capsules containing sized plutonium-238 dioxide microspheres were impacted onto a granite block. The fines (particles less than 44 μm in diameter) produced by damage to the microspheres were sized, and the percentage in each size range was determined. Author (NSA)

N68-38484# California Univ., San Diego. Dept. of Aerospace and Mechanical Engineering Sciences.
ON MARTIN'S LOWER BOUND FOR RESPONSE TIME OF IMPULSIVELY LOADED RIGID-PLASTIC STRUCTURES
Adnan Nayfeh and William Prager Jul. 1968 14 p refs
(Grant AF-AFOSR-1226-67)
(AFOSR-68-1332; TR-10; AD-674001)

Martin has given a lower bound for the time that an impulsively loaded rigid-plastic structure takes to come to rest (response time). In the evaluation of this bound, and arbitrary fixed yield mechanism is used. Even if this differs from the yield mechanisms activated in the actual motion of the structure, the lower bound may coincide with the actual response time. Cases in which this coincidence occurs are more closely investigated in the present paper, and it is shown that they must be regarded as highly exceptional. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-37496 Ohio State Univ., Columbus.
AN EXPERIMENTAL INVESTIGATION OF SHOCK INITIATED DETONATION WAVES IN A FLOWING COMBUSTIBLE MIXTURE
Leonard Anthony Hamilton (Ph.D. Thesis) 1967 192 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-2993

An investigation was made of the initiation of detonation waves in a subsonically flowing mixture of gaseous hydrogen and oxygen by means of shock waves injected opposite to the direction of the flow. Nominally stoichiometric mixtures at near ambient pressure and stagnation temperature were flowed through a constant area tube at Mach Numbers of approximately .2, .5, and .8. The shock waves were produced by a simple shock tube driver employing helium and mylar diaphragms. Piezoelectric pressure transducers, thin film heat transfer gages, and ionization probes were used to measure the various wave velocities. Dissert. Abstr.

N68-37512 Ohio State Univ., Columbus.
HEAT TRANSFER AND OTHER EFFECTS OF AN ELECTRIC FIELD ON A PARALLEL FLOW HYDROCARBON DIFFUSION FLAME
Edwin Ray Pejack (Ph.D. Thesis) 1967 168 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-3049

Effects of a transverse electric field on a parallel flow diffusion flame in a flat combustion chamber were investigated. Various mixtures of propane, nitrogen, and air were introduced separately at the base of an experimental combustion chamber and burned in a diffusion flame sheet located between flat walls of the chamber which served as anode and cathode. The electrode walls were instrumented to measure the local heat transfer rate, local current density, and pressure. A heat and mass balance on the combustion chamber revealed that while local values are significantly affected, the total overall heat transfer to the chamber walls was not appreciably changed by the applied fields. The production of unburnt solid carbon was found to be increased by the applied voltage, while the exhausted quantities of unburnt fuel and carbon monoxide were decreased. Dissert. Abstr.

N68-37580# College of Aeronautics, Cranfield (England).
DESCRIPTION OF THE ALGOL VERSION OF THE "TURBOCODE" SCHEME FOR THE PROGRAMMING OF THERMODYNAMIC CYCLE CALCULATIONS ON AN ELECTRONIC DIGITAL COMPUTER
J. R. Palmer and K. P. Annand Mar. 1968 66 p 3 refs
(CoA-AERO-203) CFSTI: HC $3.00/MF $0.65

The "Turbocode" Scheme for programming thermodynamic cycle calculations on an electronic digital computer is described. The Report describes a version, coded in Algol 60, which has been implemented on an I. C. T. 1905 computer. In view of the widespread understanding and use of Algol, the Scheme in its present form may be of considerable wider applicability than the original, subject only to variations in hardware representations. A listing of the Scheme is presented, together with flow diagrams and additional descriptive and explanatory material. Author

N68-37610*# Techtran Corp., Glen Burnie, Md.
INCREASED ACCURACY OF HIGH-TEMPERATURE MEASUREMENTS IN THE USSR [METROLGICHESKIYE RABOTY PO POVSHENIYU TOCHNOSTI IZMERENIYA VYSOKIKH TEMPERATUR V SSSR]
V. V. Kandyba et al Oct. 1968 18 p Transl. into ENGLISH of a Russian conf. paper Presented at the 4th Intern. Meas. Conf., Warsaw, 1967
(Contract NASw-1695)
(NASA-TT-F-11931) CFSTI: HC$3.00/MF$0.65 CSCL 20M

The results of studies conducted by various Soviet Agencies for the purpose of improving the techniques and instruments used in high-temperature measurements are summarized in this report. Studies show that the accuracy of scientific and industrial high-temperature measurements has been vastly improved as a result of these efforts. Author

N68-37611*# Techtran Corp., Glen Burnie, Md.
NEW METHODS AND SYSTEMS FOR THE MEASUREMENT OF ACTUAL TEMPERATURES WITH REALISTIC THERMAL RADIATION CHARACTERISTICS [NOVYYE METODY I SISTEMY IZMERENIYA ISTINNYKH TEMPERATUR PRI REAL'NOM KHARAKTERE IZLUCHENIYA]
D. Ya. Svet Oct. 1968 13 p Transl. into ENGLISH of a Russian conf. paper Presented at the 4th Intern. Meas. Conf., Warsaw, 1967
(Contract NASw-1695)
(NASA-TT-F-11932) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Some pyrometric methods for determining actual temperatures are investigated for the case where the radiation spectrum is continuous. These methods include: bichromatic pyrometry of spectral ratios, "double spectral ratio" pyrometry, trichromatic pyrometry, and relative modulation reflectometry. Certain combinations of the above methods are also examined. Tests conducted on iron, nickel, cobalt, paladium, and other metals on a relative modulation reflectometer for actual melting temperatures yielded results in good agreement with the presently accepted melting points. Author

N68-37614 Northwestern Univ., Evanston, Ill.
A TRUNCATION PROCEDURE FOR CERTAIN SPATIALLY HOMOGENEOUS PROBLEMS IN KINETIC THEORY
Charles Albert Ward (Ph.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-3237

The truncation problem associated with orthogonal polynomial solutions of the spatially homogeneous Boltzmann equation is considered. A truncation procedure is developed, and it is shown that for two types of initial distribution functions, this procedure results in moments of the distribution function which are correct in value and slope initially and at equilibrium, and in addition, the moments are independent of the zero-order distribution function used in the expansion. One of these initial distribution functions is a single species two-temperature gas mixture which has half of its particles at one-temperature and half at another, with both halves completely mixed; the other is a gas whose initial distribution function may be represented as a Maxwellian multiplied by a finite number of velocity terms. Dissert. Abstr.

N68-37654 Ohio State Univ., Columbus.
THERMAL ANALYSIS OF CERAMIC REACTION MODELS
William Buford Campbell, Jr. (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-2960

Basic relationships for conduction heat transfer have been derived and applied to reaction kinetics. The specimen thermal diffusivity has been related to reaction kinetics for both quench- and transient-surface heating conditions. Experimental verification of the derived relations has been accomplished for selected material systems. First-order, second-order, solid solution, exsolution, state change, and spinodal reactions have been identified and analyzed from dynamic differential calorimetry data. A mathematical analysis of calorimetric data was developed to determine the heat of reaction and the rate of reaction. Verification of determined heats was based on standard materials with accepted values. The Tammann model was found to be valid for change-of-state reactions. Other reactions were found to conform with the Avrami model. Dissert. Abstr.

N68-37699 Maryland Univ., College Park.
THERMAL DIFFUSION AND DIFFUSION OF HELIUM KRYPTON 85
Brian Kitfield Annis (Ph.D. Thesis) 1967 74 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-3335

The experimental investigation of thermal diffusion and concentration diffusion in a mixture of He–^{85}Kr and the interpretation of the results in terms of the intermolecular potential are described. A two bulb apparatus was used in which the concentration analysis was obtained by using the radioactive isotope of krypton in trace amounts and constructing one of the bulbs as an ionization chamber. The experimental thermal diffusion factors and diffusion coefficients were compared with those predicted by the use of the Chapman-Enskog kinetic theory and standard models for intermolecular potentials. The measurements could be fitted satisfactorily for temperatures above 200°K by the exp-6 potential with $\alpha_{12} = 13$, $(r_m)_{12} = 3.72$Å and $\epsilon_{12}/k = 40$°K. These parameters were found to be in reasonable accord with the predictions of semi-empirical combination rules. Dissert. Abstr.

N68-37715 Cornell Univ., Ithaca, N. Y.
SIMULTANEOUS HEAT AND MASS TRANSFER IN SINGLE DROP LIQUID–LIQUID EXTRACTION
William Michael Henkel (Ph.D. Thesis) 1967 267 p
Available from Univ. Microfilms: HC $12.15/Microfilm $3.45 Order No. 68-3505

Simultaneous heat and mass transfer was studied for transfer between single drops and a continuous liquid phase in liquid–liquid extraction. Temperatures were measured with thermistors arranged in a Wheatstone bridge, concentrations were measured on an ultraviolet spectrophotometer, and times of contact were measured with a motion picture camera. The systems studied were benzene–water, isooctane–water, methyl isobutyl ketone–water, benzene thickened with polymethyl methacrylate–water, benzene–aqueous methocel solutions, and benzene–aqueous glycerol. Overall heat and mass transfer coefficients were calculated. Mechanisms were determined from the velocity of rise and also by the comparison of the calculated internal coefficients with theoretical coefficients. The mass transfer coefficients were estimated from the heat transfer. The data was used in an analysis to show that the mechanism of transfer in oscillating drops can be described by continuous short time unsteady state processes. A method is suggested for separating overall coefficients of certain systems into individual coefficients. Dissert. Abstr.

N68-37743 Maryland Univ., College Park.
HEAT TRANSFER DURING VAPOR CONDENSATION IN THE PRESENCE OF NONCONDENSIBLE GAS
Charles Linfred Henderson (Ph.D. Thesis) 1967 103 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-3365

This study was initiated to determine the effect of pipe diameter, surface tension, and noncondensible gas concentration in vapor condensation on a horizontal pipe. Heat transfer coefficients were obtained for the systems toluene, steam, toluene-nitrogen, and steam-air as a function of temperature drop. The systems involving a noncondensible gas were also obtained at various gas concentrations. The data of this work and of others are used to show that, in case of condensation of pure vapors, pipe diameter

and surface tension have an effect on the condensate heat transfer coefficients. A correlation is presented as an addition to the Nusselt equation for predicting these coefficients. When a noncondensible gas is present, pipe diameter and surface tension do not seem to have as significant an effect. Contrary to Othmer's findings, the temperature of the bulk vapor stream and temperature drop between the vapor and the tube surface were not found to be of great importance during condensation when a noncondensible gas is present. A simple equation is presented which predicts the heat transfer coefficient of the combined gas and condensate film from the physical properties. The average deviation of the data from the correlation was approximately 10 percent. Dissert. Abstr.

N68-37761# Advisory Group for Aerospace Research and Development, Paris (France).
THERMOPHYSICAL PROPERTIES OF MATERIALS
Erich Fitzer Mar. 1967 127 p 168 refs
(AGARD-AR-12) CFSTI: HC $3.00/MF $0.65

The first report on a series of visits to organizations in NATO countries, undertaken by the author under the sponsorship of the Structures and Materials Panel of AGARD. It contains a survey of measurement techniques, a related bibliography and a limited compilation of data and theory on selected thermophysical properties of high temperature materials. Author

N68-37778# General Electric Co., Sunnyvale, Calif. Advanced Products Div.
EFFECT OF DENSITY ON THE THERMAL CONDUCTIVITY OF URANIUM DIOXIDE
R. R. Asamoto, F. L. Anselin and A. E. Conti Apr. 1968 52 p 27 refs
(Contract AT(04-3)-189)
(GEAP-5493) CFSTI: HC $3.00/MF $0.65

The thermal conductivity of 82, 86, 91, and 95% TD sintered uranium dioxide has been measured to within ±10% between 800° and 2000°C, in argon atmosphere by the radial heat flow technique. The data indicate that use of the Loeb equation, the Maxwell–Eucken equation, or currently recommended modifications of these thermal-conductivity-density relationships are not valid in the temperature and density ranges investigated. Thermal conductivity values for uranium dioxide were related to both temperature and density by the equation $k = 0.0130 + 1/T(0.4848 - 0.4465D)$ (watts/cm-°C) for T between 800° and 2000°C, and D between 82 and 95% TD. The time required for microstructural and/or density changes to occur in fuel elements under irradiation is short relative to its total exposure time. Because the thermal conductivity of a typical oxide fuel has been found to be quite dependent on density, a model utilizing the relationship derived in this investigation is described in which thermal conductivity and $\int$ kdT curves corrected for fuel densification can be generated. The thermal conductivity characteristics of hot-pressed uranium dioxide are also discussed. Author (NSA)

N68-37842# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
HEAT TRANSFER NOTES [NOTE DI SCAMBIO TERMICO]
M. Cumo 1968 302 p 6 refs In ITALIAN; ENGLISH summary
(RT/ING(68)9) CFSTI: HC $3.00/MF $0.65

Forced convection heat transfer has been investigated through a series of topical studies. First single phase-forced convection typical coolants are considered (water, organics, liquid metals and gas), then boiling is studied, from subcooled through bulk boiling, and the departure from nucleate boiling in dependence of experimental conditions and duct geometry. There is particular insight on two-phase flows in which the liquid is the dispersed phase. mixture constitution and cooling properties are studied. Throughout the work boiling mechanisms are employed. Author

N68-37852*# Little (Arthur D.), Inc., Cambridge, Mass.
ADVANCED STUDIES ON MULTILAYER INSULATION SYSTEMS Final Report
James Barber 31 Jan. 1968 171 p refs
(Contract NAS3-7974)
(NASA-CR-72368; ADL-69013-00) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The heat flow contributed by a pipe penetration in a multilayer insulation was determined with analytical and experimental models. The penetration was a 17-inch-long, 6-inch-diameter stainless steel tube with a 0.025-inch wall thickness. This was connected to a LN_2 calorimeter tank with a 10-shield insulation system. Heat flows of about 15 and 46 Btu per hour were obtained with warm end temperatures of 540° and 750°R respectively. Heat flows that were about 35 percent lower than these values were obtained by selectively lowering the emittance of the penetration interior. In a separate task, a heat flux of 0.33 Btu per hour was obtained on a 5-shield multilayer insulation, both before and after storage for one year. Author

N68-37933# Bureau of Mines, Pittsburgh, Pa.
LARGE SCALE STUDIES OF GAS DETONATIONS
D. S. Burgess, J. N. Murphy, N. E. Hanna, and R. W. Van Dolah Nov. 1968 59 p refs
(BM-RI-7196)

The characteristics of gas phase detonations were observed in 20 instrumented firings within earthen tunnels, in 100 such detonations in a 24-in-diam by 163-ft-long steel pipe, and in about 200 smaller firings. Most of the fuels studied were representative hydrocarbons—acetylene, propane, gasoline, and a roughly equimolar mixture of methylacetylene, propadiene, and propane. In a pipe with two closed ends, the detonable limits were demonstrated to be very nearly the same as reported limits of flammability. The side-on impulses were shown to be the same function of concentration regardless of whether deflagration or detonation had occurred. In a pipe with only the initiation end closed, the impulses of all fuel–air systems tended toward the same level when averaged over comparable ranges of fuel concentration and unexpectedly high impulses were obtained with slightly lean mixtures. In earthen confining structures, the impulse of the explosion was efficiently converted into momentum of the failing wall. An earth velocity of about 20 fps was critical to overcome the soil's resistance to shear. The assignment of a TNT equivalent is discussed in terms of the confinement of the mixture. Author

N68-37960# Oak Ridge National Lab., Tenn.
THERMODYNAMIC ANALYSIS OF THE SOLID SOLUTIONS OF CARBON, NITROGEN, AND OXYGEN IN NIOBIUM AND TANTALUM
E. Fromm 10 Jul. 1968 16 p refs Transl. into ENGLISH from J. Less-Common Metals, no. 14, 1968 p 113–125
(ORNL-TR-1942) CFSTI: HC $3.00/MF $0.65

Data necessary for the thermodynamic analysis of the α-solid solution phase for the systems Nb–C, Nb–N, Nb–O, Nb–C–O, Ta–C, Ta–N, Ta–O, and Ta–C–O were compiled and discussed. In addition, the equilibrium pressures of N_2, Co, O_2, O, NbO, NbO_2, TaO, and TaO_2 are given over the solid solution region of niobium and tantalum as a function of the temperature and concentration. From this, it is possible to estimate the role which is played by the individual gas absorption and degassification reactions in the various pressure and temperature ranges. Author (NSA)

N68-37994# Aeronautical Research Council (Gt. Brit.)
BIBLIOGRAPHY OF HEAT-TRANSFER INSTRUMENTATION
F. J. Bayley and A. B. Turner Nov. 1966 62 p refs
(ARC-R&M-3512; AD-834124) HMSO: £1 6S 6D

Section I of this bibliography concerns techniques of measurement with heat-flux meters and their application in various specialist fields. The second Section deals entirely with

thermocouples, lists the types available, their calibration and thermocouples for special purposes. The particular difficulties of measuring surface temperatures are dealt with in Section III and a variety of means of dealing with this very important experimental problem is surveyed. Chapter IV on kinetic heating is concerned with the special problems of measurement in aircraft structures and missiles. The last three chapters deal successively with the special techniques required for measurement of radiation, the application of phase change methods and lastly the uses of resistance thermometers. About one hundred references are dealt with in these seven sections. TAB

N68-38015*# Lockheed Missiles and Space Co., Palo Alto, Calif.
SURFACE EFFECTS RESULTING FROM TEKTITE ABLATION
J. O. Golden and M. L. Blackledge Aug. 1968 74 p refs
(Contract NAS8-20082)
(NASA-CR-61243; LMSC/HREC-A791443) CSCL 20M

Results are presented of an experimental investigation to evaluate the types of surface structure produced during the ablation of tektite materials in the exhaust plume of small rocket test engines. A series of ablation tests, including firings on both natural and synthetic tektite materials, was conducted in the exhaust plumes of rocket test engines fueled with liquid oxygen/hydrogen and liquid oxygen/kerosene. The surface structure features produced on the tektite material were then compared to those found on natural tektites. Photographic results of these tests are presented. In addition, high-speed photography was used to evaluate the surface structure during the actual ablation experiments. Author

N68-38083# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
EQUILIBRIUM THERMODYNAMIC DATA FOR THE H2-O2-He SYSTEM
Andre Benoit Aug. 1968 73 p refs
(Contract AF 33(615)-5313)
(UTIAS-TN-128; AD-674204) CFSTI: HC $3.00/MF $0.65

This note presents equilibrium thermodynamic data, in graphical form, for the H2-O2-He system considered as a possible high enthalpy driving gas for hypervelocity applications. The weight formula of the basic system is expressed as (2H2 + O2) + m H2 + n He, and molar dilutions of the stoichiometric hydrogen-oxygen system up to 67% are envisaged. For these mixtures, composition data, thermodynamic data and relevant partial derivatives are given assuming thermodynamic equilibrium, for temperatures ranging from 2000K to 5000K and pressures from 0.01 to 10,000 atm. More specifically, these data include mole fractions, molecular weight, enthalpy, density, logarithmic first partial derivatives with respect to temperature at constant pressure or with respect to pressure at constant temperature of molar fractions and molecular weight, equilibrium specific heat, isentropic exponent, and equilibrium and frozen speeds of sound. Author (TAB)

N68-38144# RAND Corp., Santa Monica, Calif.
FEASIBILITY OF ROTATIONAL DESTRATIFICATION OF SPACE-STORED LIQUID CRYOGENS
Ivan Catton and Michael Sherman Aug. 1968 30 p refs
(Contract F44620-67-C-0045)
(RM-5693-PR; AD-674585)

A method is presented for determining the onset of a thermally induced convective mixing motion in a model of a cylindrical space-storage tank subjected to a constant heat flux at its outer boundary. The model simulates a completely filled liquid cryogen tank with shear-free ends rotating in a low-gravity environment. The governing disturbance equations reduce to a self-adjoint eigenvalue problem for the critical Rayleigh number (the stability criterion). Using the Rayleigh–Ritz technique of approximating eigenvalues with an equivalent variational principle, the critical Rayleigh number is calculated as a function of the Taylor number (ratio of Coriolis forces to viscous forces) and the aspect ratio (length-to-diameter ratio) of the cylindrical tank. Results indicate that the critical Rayleigh number is a monotonically increasing function of Taylor and a monotonically decreasing function of aspect ratio. It is found that relatively small rotational speeds will initiate and maintain a thermally destratifying convective motion within a vessel filled with liquid hydrogen. This method of mixing has the advantage of having no moving parts within the tank. It also provides a means for thermal control of space-storables. Author (TAB)

N68-38151# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF TURBULENT HEAT EXCHANGE ON A SEMIPERMEATED SURFACE WHEN A FOREIGN GAS IS BLOWN IN [K RASCHETU TURBULENTNOGO TEPLOOBMENA NA POLUPRONITSAEMOI POVERKHNOSTI PRI VDUVE INORODNOGO GAZA]
S. S. Kutateladze, A. I. Leontev, and B. P. Mironov 20 Oct. 1967 10 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 5, 1966 p 123–125
(FTD-HT-23-928-67; AD-674398)

A method is presented for calculating the heat transfer on a semipermeable surface under conditions of subsonic flow with foreign gas injection. The method is based on the solution of the energy equation and the use of the asymptotic theory of the turbulent boundary layer. The obtained results show that the rate of injected gas is only slightly affected by the physical properties of injected and main gases. Author (TAB)

N68-38159# Pennsylvania State Univ., University Park. Fuel Science Section.
SOME EXPERIMENTAL TECHNIQUES USED IN CARBON REACTION STUDIES
R. H. Essenhigh, R. W. Froberg, and L. Kurylko Jun. 1968 27 p refs
(Contract Nonr-656(29)
(FS68-1(U); AD-674425) CFSTI: HC $3.00/MF $0.65

Temperature, weight and size measurements of reacting carbon spheres can be made simultaneously in an electrically heated furnace. Combining these measurements with gas sampling, surface area, and density profile determinations, the progress and process of heterogeneous solid-gas and of subsequent gas phase reactions can be established. Measurements of atmospheric conditions gave results revealing the true order of chemical reaction of carbon with oxygen, allowed the determination of the depth of penetration of the reaction zone into carbon, established the presence of an oscillatory combustion phenomena, etc. Problem areas to be encountered by the experimenter with the above techniques are pointed out. Author (TAB)

N68-38210# Purdue Univ., Lafayette, Ind. Thermophysical Properties Research Center.
DESCRIPTION OF A CONTINUING PROGRAM ON TABLES OF THERMOPHYSICAL PROPERTIES OF MATERIALS Summary Technical Report, 1 Jan.–31 Dec. 1967
C. Y. Ho Wright-Patterson AFB, Ohio AF Mater. Lab. Jun. 1968 102 p refs
(Contract AF 33(615)-2281)
(AFML-TR-68-98; AD-674608) CFSTI: HC $3.00/MF $0.65

This technical report covers work on a continuing systematic program involving the search, collection, extraction, organization, evaluation, correlation, analysis, and synthesis; the preparation of intermediate tables presenting the available total experimental information; and the final preparation of internally consistent tables of data referred to as Tables of Recommended Most Probable Values. The work reported on consists of tables projects on the thermal conductivity, specific heat, thermal radiative properties (emittance, reflectance, absorptance, transmittance, and solar

radiation coefficient), and thermal diffusivity of metallic and nonmetallic elements, alloys, compounds, mixtures, and systems, and the thermal conductivity, specific heat, and viscosity of liquids and gases. This report does not contain the completed data sheets for these properties and materials, but does reproduce in the Appendix, Table of Contents and List of Figures and Tables and Organization of Materials for each of the seven forthcoming volumes (which contain over 7000 data sheets) of the new TPRC Series on Thermophysical Properties of Matter and also the Directory of Materials for the remaining chapters in the existing TPRC Data Book not covered in the seven volumes mentioned above. Author (TAB)

N68-38225# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE HEAT BARRIER
Vee Yeh 21 Dec. 1967 10 p Transl. into ENGLISH from Hang K'Ung Chin Shih, v. 2, no. 3, 1965 p 8–10
(FTD-HT-23-590-67; AD-674398) CFSTI: HC $3.00/MF $0.65

In a discussion of the heat barrier, the author first explains how this heat is produced. He notes that the problem was first discovered by the Germans in their experiments with V-2 rockets. He then describes the methods used to solve the problem. There are essentially two approaches to carry away the heat: by absorption and by radiation. The absorption techniques include: (1) Cooling by convection; the aircraft or rocket has a double wall with a gas or a liquid cooling agent in between to absorb the heat; (2) Cooling by evaporation; liquid is ejected from tiny holes punched in the wall of the aircraft; (3) Cooling by conduction; a thick shield is used and the heat is conducted away; (4) The burnout device; a protective layer is mounted on the craft; high temperature melts and burns this layer or starts a chemical reaction which absorbs large quantities of heat. The radiation technique uses an insulator which has a high radiation power. Author (TAB)

N68-38291# Office of Naval Intelligence, Washington, D. C.
AN EXPERIMENTAL STUDY OF THE ROLE OF THE NON-STATIONARY CHARACTER AND NON-ONE-DIMENSIONALITY OF THE ZONE OF COMPONENT TRANSFORMATION IN THE COMBUSTION PROCESS IN CONDENSED MIXTURES [EKSPERIMENTAL'NOYE ISSLEDOVANIYE ROLI NESTATSIONARNOSTI I NEODNOMERNOSTI ZONY PREVRASHCHENIYA KOMPONENTOV V PROTSESSE GORENIYA KONDENSIROVANNYKH SMESSY]
S. S. Novikov, P. F. Pokhil, Yu. S. Ryazantsev, and L. A. Sukhanov 3 Jul. 1968 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR)
(ONI-TRANS-2631; AD-674488) CFSTI: HC $3.00/MF $0.65

The objective of the study was clarification of the role of one factor characteristic of the process of combustion of condensed mixtures and usually absent (or unimportant) in the process of combustion of individual explosives and nitroglycerine powder. This characteristic is the nonstationary character and non-one-dimensionality of the combustion zone. In the experiments the fuel used was plexiglass and the oxidizer was pulverized potassium perchlorate. Author (TAB)

N68-38462# Cambridge Univ. (England). Cavendish Lab.
GROWTH OF BURNING TO DETONATION IN LIQUIDS AND SOLIDS Progress Report, Nov. 1967-Jun. 1968
F. P. Bowden, J. E. Field, P. G. Fox, and M. M. Chaudhri Jun. 1968 13 p refs
(Grant AF-EOAR-68-0001)
(AFOSR-68-1789; AD-674005) CFSTI: HC $3.00/MF $0.65

A high-speed photographic study was made of the initiation of explosion in liquids and single crystals of explosive solids. The physical homogeneity of the material is shown to have a marked effect on sensitivity. An extension is made to thermal explosion theory. Author (TAB)

N68-38464# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TURBULENT MIXING OF TWO SEMI-INFINITE STREAMS OF REACTING GASES [TURBULENTNOE PEREMESHIVANIE DVUKH POLUBESKONECHNYKH POTOKOV REAGIRUYUSHCHIKH GAZOV]
E. F. Avdeev, F. Aliev, and Yu. V. Lapin 5 Jan. 1968 19 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst., no. 265, 1966 p 65–74
(FTD-MT-24-361-67; AD-674045) CFSTI: HC $3.00/MF $0.65

An analysis was made of the turbulent combustion of two parallel semi-infinite streams of reacting gases. It was assumed that the reaction rate is infinite, the combustion zone has a zero thickness, and the concentration of the oxidizer and fuel are zero at the flame surface. Solutions were obtained for Prandtl and Schmidt number differing from or equal to unity. For the case of Pr and Sc = 1, velocity, temperature, and concentration profiles were calculated for carbon monoxide combustion at 9 cm and 49 cm from the outlet. The calculations showed that a deviation of Pr and Sc from unity does not substantially affect the location of the flame front. Author (TAB)

N68-38481# Boeing Co., Renton, Wash. Commercial Airplane Div.
THE EFFECTS OF ORGAN PIPE OSCILLATIONS ON FLAME PROPAGATION IN TUBES AND SAFOM AS A FLAME ARRESTER IN AIRPLANE VENT SYSTEMS
R. Laustsen 9 Aug. 1968 31 p refs
(D6-58381TN; AD-674419) CFSTI: HC $3.00/MF $0.65

The paper describes a program to investigate the nature of flame propagation in a duct system of variable geometry, particularly the effect of acoustical disturbances; and to evaluate SAFOM as an arrester in ducts, and establish criteria for its use. Tests show that fuel mixture ratio, organ-pipe oscillation, and system configuration are involved in the flame quenching capability of SAFOM and a combination of SAFOM and metal screens. Zones where arrest cannot occur are detected, and the arrester combination of SAFOM and metal screen is recommended for quiescent conditions. However, if the combustible mixture is flowing, the arrester (SAFOM and/or screens) acts as a flame-holder until failure occurs. Author (TAB)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-37665 Michigan State Univ., East Lansing.
A STUDY OF THE ROLE OF THE ENGINEERING MANAGER AND HIS CONTINUING EDUCATION REQUIREMENTS
Charles Alan McKee (Ph.D. Thesis) 1967 288 p
Available from Univ. Microfilms: HC $13.05/Microfilm $3.70
Order No. 68-4187

The main purpose was to investigate the relationships among the perceptions engineering managers have of their role, their continuing education activities, and subject area needs, and among the expectations held for them by their immediate superiors, direct subordinates, and by engineering faculty outside of the organization. Role theory was adopted as the conceptual approach to study the position of the engineering manager. As a general conclusion of

the entire study: (1) The engineering managers showed the highest degree of consensus of the four individual groups. (2) The engineering managers and the immediate superiors showed the highest degree of consensus of the compared groups. (3) The engineering managers and the immediate superiors showed the lowest number of significant differences of the compared groups.
Dissert. Abstr.

N68-37766*# American Bar Foundation, Chicago, Ill.
THE LAW RELATING TO ACTIVITIES OF MAN IN SPACE, CHAPTERS 1–4 Final Report
S. Houston Lay and Howard J. Tauben Oct. 1968 391 p refs
(Contract NSR-14-041-001)
(NASA-CR-97320) CFSTI: HC $3.00/MF $0.65 CSCL 05D

National and international law-making was studied to determine the relevant rules that appear to exist and the areas in which consensus and rule-making are now or will become essential. Space environment, the solar system and its constituents, and the contents of empty space are considered; as are the political-legal setting for outer space activities and the continuing peaceful-hostile nature of space competence. Sovereignty based on an extension of territory outward and upward is treated; and both the viewpoints of the United States and the Soviet Union are expounded, including the outer limit of the airspace, the inner limit of outer space, and space vehicles in the airspace. Claims to sovereignty over outer space are reviewed and analogies to the high seas, airspace, and Antarctica are presented. The present legal order is delineated, including the legal status of artificial bodies, space stations, equipment, and men in outer space.
M.W.R.

N68-37767*# American Bar Foundation, Chicago, Ill.
THE LAW RELATING TO ACTIVITIES OF MAN IN SPACE, CHAPTERS 5–7 Final Report
Houston Lay and Howard J. Tauben Oct. 1968 293 p refs
(Contract NSR-14-041-001)
(NASA-CR-97307) CFSTI: HC $3.00/MF $0.65 CSCL 05D

The legal regime of satellite communications; liability and space activities; and natural resources, pollution, and the law of activities in space are discussed in terms of problems created by advanced technological developments for communications and space utilization. Both national and international aspects of the law are considered, including ComSat legislation by the United States and the legal status of Intelstat. Financing and costs of communications satellites, allocation of electromagnetic wave frequencies, and radio spectrum limitations are among the topics reviewed. Various aspects of legal liability reviewed include falling boosters, spacecraft, and debris; radio interference; reporting and modifying weather; and navigation aids. Making and resolving claims, sources of compensation for damages, and relationships between claimant states and injured parties are considered. Space resources and their exploitation as well as space activities and natural resources on the earth are also covered.
M.W.R.

N68-37768*# American Bar Foundation, Chicago, Ill.
THE LAW RELATING TO ACTIVITIES OF MAN IN SPACE, APPENDICES A–D Final Report
Houston Lay and Howard J. Tauben Oct. 1968 232 p refs
(Contract NSR-14-041-001)
(NASA-CR-97323) CFSTI: HC $3.00/MF $0.65 CSCL 05D

Jurisdiction of the United States over crimes and other acts in outer space is discussed, using precedence set by cases involving travel on the high seas and in aircraft. Domestic use of communication satellites and aspects of government control and private industry responsibilities are covered in another appendix. A third appendix provides an overview of the past and present role of the United Nations and outer space activities, including the positions of various nations. The roles of the International Civil Aviation Organization (ICAO) and other international agencies are cited; and mention is made of some bilateral and multilateral arrangements, including various agreements with the Soviet Union. The fourth appendix is a listing of U.S. military space programs. A guide is included for the study of the legal and political aspects of space exploration. This consists of listings of legal and non-legal research aids available; major publications of nongovernment institutions, international organizations, and the United States Government; and a selective topical bibliography of American and foreign sources on the law of space.
M.W.R.

N68-37813*# Washington Univ., St. Louis, Mo. Dept. of Economics.
A MODEL OF THE DISTRIBUTION OF FEDERAL EXPENDITURES AMONG STATES
Maw Lin Lee and Louis Silversin Oct. 1968 21 p 7 refs
Its Working Paper No. 6817
(Grant NsG-342)
(NASA-CR-97358) CFSTI: HC $3.00/MF $0.65 CSCL 05C

The statistical model was developed on the assumption that the distribution of federal expenditures is governed by the objectives and functions of federal programs to deal with social and economic problems and to procure goods and services for government. Social and economic problems as well as the ability of a state to function as a supplier to the federal government are assumed to be associated with the extent of its industrialization, urbanization and other factors. These factors are incorporated to explain the distribution of federal expenditures. The results in general are consistent with the hypotheses. The simultaneous equation approach is still in its infancy as an analytic tool for government fiscal activity. For this reason, the statistical model developed and applied here should be considered as an exploratory one. But the study illustrates that this research methodology can be fruitfully applied to the investigation of the distribution of federal expenditures among regions and states.
Author

N68-37818# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
FLOW CONTROL—AN INVESTIGATION OF A TECHNIQUE FOR PREDICTING DEMAND AND SERVICE AT THE TERMINAL FACILITY Final Report
Gordon D. Jolitz 1968 44 p 2 refs
(AD-673667)

The concept of the flow control function as a part of the Air Traffic Control (ATC) system includes a requirement for information about the volume of air traffic demand on the ATC system relative to the systems capacity for servicing such a demand. Furthermore, the information is needed sufficiently far in future time to permit action to be taken when a serious imbalance is predicted. The demand prediction process described in this report was based on two related hypotheses: (a) air traffic demand on an airport is repetitive in nature such that historical operations data would be useful as a predictor; and (b) operations information known to the Air Traffic Control (ATC) system would be a useful predictor. A computer program was developed which permitted joint use of the two predictors and, using sample data from a test case (Washington National) airport, the prediction model was evaluated. A companion program which was designed to provide service predictions took into account such environmental factors as weather and runway configuration.
Author (TAB)

N68-37859# Advisory Group for Aerospace Research and Development, Paris (France).
INFORMATION BULLETIN, MAY 1968
May 1968 22 p refs
(AGARD-IB-68/12) CFSTI: HC $3.00/MF $0.65

Staff member assignment changes are mentioned and brief accounts are given on panel membership, activities, plans, and publications. A calendar of AGARD meetings for 1968 is included.
E.C.

N68-38025# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTALS OF THE PLANNING OF AIRCRAFT INDUSTRY PLANTS AND SHOPS
V. A. Tikhomirov 1967 759 p refs Transl. of the Book "Osivovy Proektirovaniya Samoletostroitelnykh Zavadov i Tsekhov" Moscow, Masheiz., 1965 p 1–499
(FTD-HT-67-189; AD-674737)

The book presents methods of designing aircraft plants and shops; it considers the main stages of designing, selection of the construction site, designing the master plan, designing the main and auxiliary shops of the plant and its airfield, facilities for mechanizing production processes and methods of elaborating the economic part of the project. In addition, the book presents data on norms which are needed in designing. It also serves as a textbook for students of aviation colleges; and will be useful to engineering and technical workers of enterprises of the aircraft industry. Author (TAB)

N68-38127# Congress. House. Committee on Science and Astronautics.
JOINT HOUSE-SENATE COLLOQUIUM TO DISCUSS A NATIONAL POLICY FOR THE ENVIRONMENT
17 Jul. 1968 238 p Presented at the Hearing before Comm. on Interior and Insular Affairs, U.S. Senate and the Comm. on Sci. and Astronautics, U.S. House of Representatives, 90th Congr., 2d Sess., 17 Jul. 1968
GPO: HC $1.00

In order to survey policies for environmental management, hearings were held pertaining to the important environmental activities affecting the management of resources, urban and rural developments, science and technology programs, and human health. Discussion also centered on the directions environmental policy should take to make physical surroundings more stable, more productive, more healthful, and more esthetically pleasing for all citizens. A report is included on the need for a national environment policy. Requirements for policy effectiveness are defined, and questions of implementation are posed. The environmental legislation introduced in the 90th Congress is discussed, along with Federal administration and oversight of environmental programs. M.G.J.

N68-38325# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON EASTERN EUROPE SCIENTIFIC AFFAIRS, NO. 16
10 Oct. 1968 62 p refs Transl. into ENGLISH from various foreign publ.
(JPRS-46640) CFSTI: HC $3.00/MF $0.65

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1. SATELLITE TRACKING STATION DESCRIBED M. Gogoshev p 1–6 (See N68-38326 24-07)
2. EARLY MATURING WHEAT VARIETIES DEVELOPED T. Rachinski p 7–8
3. CENTRALIZATION OF MEDICAL LABORATORIES URGED G. Mickel p 9–16
4. DEVELOPMENT OF CHEMICAL SCIENCES IN POLAND W. Trzebiatowski et al p 17–53 (See N68-38327 24-06)
5. THIRD SCIENTIFIC SESSION OF THE CENTER OF ECONOMIC COMPUTATION AND ECONOMIC CYBERNETICS E. Nicolau p 54–57

N68-38445*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.
A STUDY OF ALTERNATE MEANS OF IMPLEMENTING A HORIZON DEFINITION EXPERIMENT. VOLUME 2: SUPPORT DATA Final Report
1 Nov. 1968 41 p
(Contract NAS1-8187)
(NASA-CR-66702) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Cost data are detailed in relation to implementing an horizon definition experiment, and star availability for star field mapping is considered. Results of the latter were obtained during an investigation of the suitability of star sensors for precise spacecraft reference for an application other than the horizon definition experiment mission. A listing of 225 stars brighter than 6.5 visual magnitude is included, as are data on star sightings for each five degrees of orbit angle advance starting with the northbound crossing of the equator. Latitude of the spacecraft at each of the sighting times is given, the viewing sensor for each orbital position is noted, and the spacecraft was assumed to have been launched into an 84.7° inclined orbit at 2230 GMT April 24, 1968. M.W.R.

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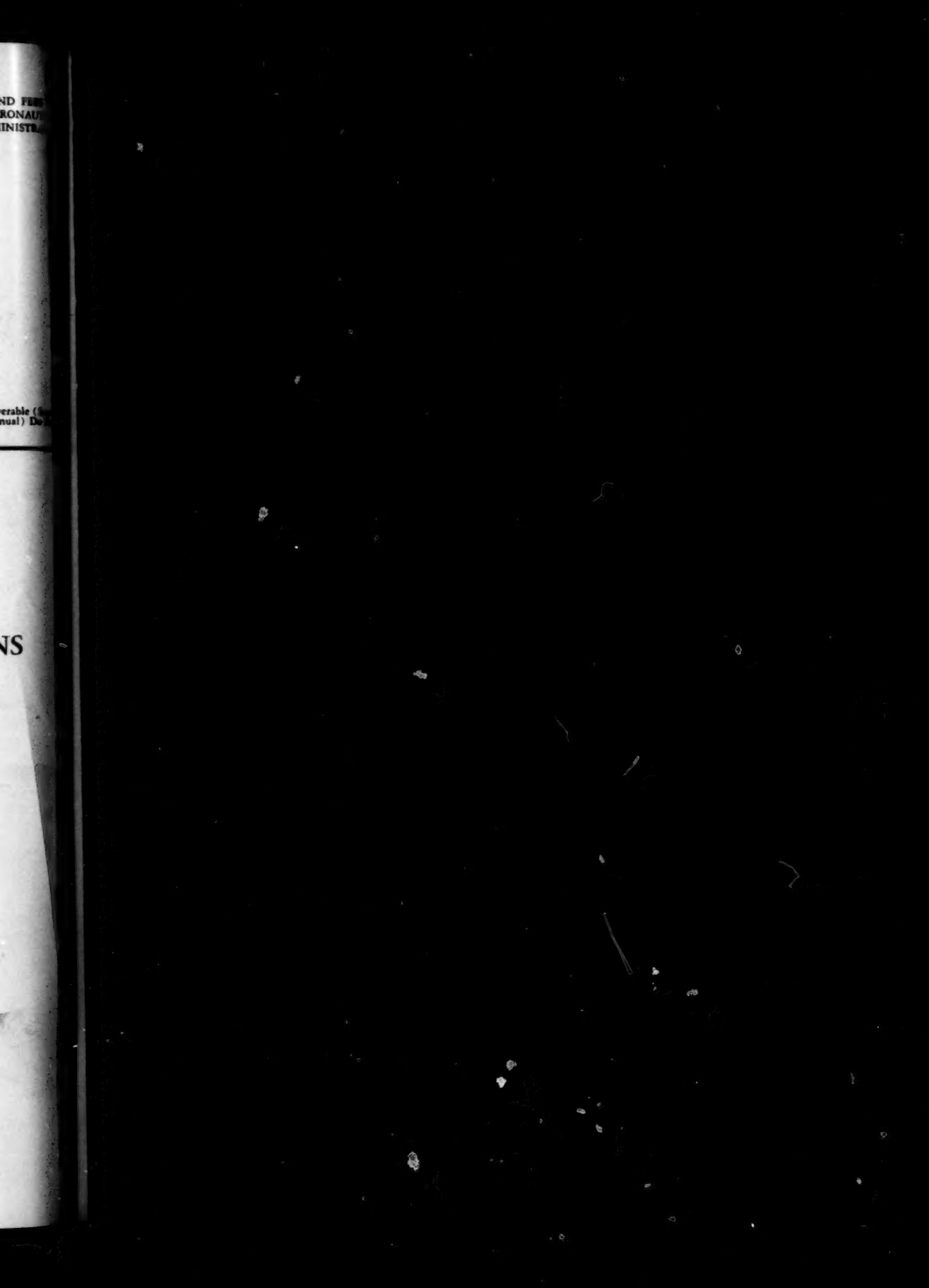
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